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VOLUME 4, NUMBER 9MAY 1, 1971

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WATER RESOURCES ABSTRACTS

'A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of the Interior



VOLUME 4, NUMBER 9 MAY 1, 1971

W71-04351 -- W71-04850

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the Water Resources Thesaurus (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

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Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency, Water Quality Office. A directory of the Centers appears on inside back cover.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center Office of Water Resources Research U.S. Department of the Interior Washington, D. C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

02. WATER CYCLE

2A. General

ISOTOPIC HYDROLOGICAL STUDIES OF THE NORTHWEST SAHARA (FRENCH),

Centre de Recherches sur les Zones Arides, Paris (France); and Paris Univ. (France). Faculte des Sciences.

G. Conrad, and J. Ch. Fontes.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/24, p 405-419, 1970. 15 p, 5 fig, 7 tab, 16 ref.

Descriptors: *Surface-groundwater relationships, *Stable isotopes, *Deserts, *Water balance, Precipitation (Atmospheric), Evaporation, Recharge, Discharge (Water), Deuterium, Oxygen, Aquifers, Streamflow, Arid lands.
Identifiers: *Sahara, *Oxygen isotopes.

Study of the paleovalley of the Saoura Wadi in the northwestern Sahara includes an examination of the isotopic composition of the aquifer, the precipitation, and the surface system. The collection of samples from every precipitation at Beni Abbes on the present middle course of the Saoura provides a mean of determining the O-18 content of the heaviest rain storms which could feed the reservoirs, and of assessing the weighted mean isotopic composition of this contribution. The influence of evaporation on the river waters can be estimated from the south side of the Sahara Atlas mountains where the floods originate to the endorheic basin of the Sebkha-al-Melah, where the water evaporates. On the middle course of the Wadi, the loss through evaporation is partially compensated by a contribution from aquifers whose existence was brought to light by continuous comparative study of the isotopic composition of the Wadi waters and the Great Western Erg waters. The other regional reservoirs connected with the Saoura valley have also had their O-18 content determined. The Saoura paleovalley is also a line along which a water body found at various depths throughout the north Sahara discharges. Samplings in this aquifer, both in the Saoura valley and throughout the western Sahara, can be used for making a specific study of the western part of this reservoir. The data obtained are compared with findings for the other reservoirs, the surface system and present precipitation. (Knapp-USGS)

PEAK DISCHARGE AND TIME OF CONCENTRATION RELATION TO RAIN INTENSITY INVESTIGATED BY PHYSICAL MODELS OF WATERSHEDS.

Prague Agricultural Univ. (Czechoslovakia) Jaromir Nemec, and Miloslav Moudry. In: Floods and Their Computation, Vol 1, International Association of Scientific Hydrology Publica-tion No 84 (Unesco-WMO), p 510-518, 1969. 9 p, 2 fig, 1 tab, 23 ref.

Descriptors: *Rainfall-runoff relationships, *Model *Models, *Hydraulic models, *Simulated rainfall, *Mathematical models, Analog models, Hydraulic similitude, Hydrograph analysis, Synthetic hydrology, Peak discharge, Rainfall intensity, Time of contents to the contents of centration.

Identifiers: Watershed models.

Different factors influencing the flood flow in small basins can be expressed as a function of the concentration or lag time. From the example of an experimental basin in Czechoslovakia, the relationship of concentration time and peak discharges is demonstrated. The recurrence interval of the peak discharge and the rain intensity are also taken into consideration. In order to investigate the influence of different factors on the concentration time, models of rainfall-runoff process are considered. A physical model of a watershed is being developed.

The process is simulated with the help of a rain simulator. Watershed models in different scales are used to investigate the development of similarity criteria. Theoretical approaches to the similarity problem are discussed and the approaches through dimensional analysis and differential equations of motion are described. Further investigations aiming to relate the prototype to the model are considered. (Knapp-USGS) W71-04388

THE FLOOD FORECASTING BY A SERIES STORAGE TYPE MODEL,

National Research Center for Disaster Prevention. Tokyo (Japan).

M. Sugawara.

In: Floods and Their Computation, Vol 1, International Association of Scientific Hydrology Publication No 84 (Unesco-WMO), p 555-560, 1969. 6 p,

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Surface-groundwater relationships, *Flood forecasting, Water storage, Infiltration, Hydrograph analysis, Storm runoff, Computer models.

Identifiers: Series storage models.

The series storage rainfall-runoff model is a structure composed of storage models arranged vertically in series. The storage type model is based on the hypothesis that both discharge and infiltration are functions of the amount of water stored in the ground. In the case of low rainfall, water passes through the first structure at the top of the series model and it runs off from the second or third structure with a smoothed hydrograph and time lag. Heavy rain however results in water discharging from the first structure as a flood. The discharge from the second or third structure forms the gradual fall of the hydrograph after the flood. This model seems to be useful for runoff analysis in general, including floods. A digital computer program was written to calculate numerical solutions using the series storage model. (Knapp-USGS) W71-04390

METEOROLOGICAL CAUSES OF RAINFALL FLOOD OCCURRENCES IN THE BASIN OF THE UPPER VISTULA,

State Inst. of Hydrology and Meteorology, Warsaw (Poland).

For primary bibliographic entry see Field 02B. W71-04392

THE SIGNIFICANCE OF CHARACTERISTICS OF BASIN RAINFALL AND MORPHOMETRY IN A STUDY OF FLOODS IN THE UNITED KINGDOM,

Hydrological Research Unit, Wallingford (En-

gland). J. C. Rodda.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 834-845, 1969. 12 p, 3 fig, 3 tab, 15 ref.

relationships. *Rainfall-runoff Descriptors: *Geomorphology, *Rainfall disposition, *Distribu-tion patterns, *Frequency analysis, Peak discharge, Rainfall intensity, Rational formula, Routing, Streamflow forecasting, Flood forecasting, Statistical methods.

Identifiers: United Kingdom.

There are various ways of predicting floods on ungaged rivers. One method is to employ a formula relating peak discharges for basins where flows are measured to the characteristics of those basins. Such a formula was devised by multiple regression analysis, using records from 26 small basins in Britain. Magnitude-frequency relations were determined for the floods in each basin and the mean annual floods were related to characteristics of basin rainfall and morphometry. The rainfall term was obtained from a countrywide study of intense rain

using daily maximum falls, while basin area and drainage density were employed as the other variables. Use of all these factors in the multiple regression analysis produced the most satisfactory formula for predicting the mean annual flood. However because of the errors it involved, which were due in part to variations in geology and surface condi-tions, it was suggested that future studies should be based on the regional analysis approach. (Knapp-USGS) W71-04393

DETERMINATION OF STORM RUNOFF BY THE USE OF INFILTRATION INDEX.

Ministry of Railways, Lucknow (India).

A. Bhatnagar.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publica-tion No 85 (Unesco-WMO), p 804-810, 1969. 7 p, 3 fig, 1 tab, 4 ref.

Descriptors: *Storm runoff, *Streamflow forecasting, Interception, Water storage, Infiltration, Antecedent precipitation, Rainfall, Duration curves, Discharge (Water), Hydrograph analysis, Deptharea-duration analysis Identifiers: India.

Storm runoff can be estimated quite accurately by an estimate of interception, retention and an infil-tration index which includes other minor losses such as evaporation and transpiration. Hydrological data of 17 representative catchments in Central India were analyzed to estimate initial losses and infiltration indices occurring during storms. A coaxial relation between infiltration index, the antecedent precipitation index, storm rainfall and storm duration has also been evolved for the region. If storm duration, storm rainfall and antecedent precipitation conditions are known, the infiltration index during a storm on a catchment in this region can be determined. Storm runoff can then be estimated by subtracting initial loss and infiltration index from storm rainfall rates. (Knapp-W71-04397

INTERRELATION OF RIVER WATER AND UN-DERGROUND WATER DURING FLOOD PERIODS.

Moscow State Univ. (USSR).
A. I. Chebotarev, O. V. Popov, and B. I. Koudelin. In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 797-803, 1969. 7 p, 2 fig, 2 tab, 4 ref.

Descriptors: *Surface-groundwater relationships, *Bank storage, *Floods, *Base flow, Hydrogeology, Aquifers, Streamflow, Discharge (Water), Infiltration, Recharge, Water levels, Water level fluctuations, Hydrograph analysis. Identifiers: USSR, Bank regulation.

Flood wave formation involves the interrelation of river and underground waters. Water exchange between river and river-side aquifers must be taken into consideration. In the USSR this phenomenon is generally referred to as bank regulation. It results in time redistribution of streamflow and underground river recharge, in decrease in maximum discharge, and increase in low water flow in the period between floods. The bank regulation effect is dependent on the hydrogeological structure of river valleys and on river regime. The principles of bank regulation in different hydrogeological conditions are outlined. Data characterizing the bank regulation effect under different physiographical conditions are given. (Knapp-USGS) W71-04398

STATISTICAL CORRELATION OF HIMALAYAN AND BUNDELKHAND BASIN CHARACTERISTICS WITH FLOOD FLOWS, Uttar Pradesh Irrigation Research Inst., Roorkee (India).

Field 02-WATER CYCLE

Group 2A-General

For primary bibliographic entry see Field 04A. W71-04411

CONDITIONS LEADING TO THE FORMATION OF RAIN FLOOD FLOW ON SMALL RIVERS IN THE SOUTHERN PART OF THE FAR EAST, Far Eastern Hydrometeorological Research Inst., Vladivostok (USSR).

I. N. Hartzman

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publica-tion No 85 (Unesco-WMO), p 932-940, 1969. 9 p, 2 fig, 3 ref.

Descriptors: *Rainfall-runoff relationships, *Flood routing, *Routing, Time lag, Hydrologic data, Peak discharge, Water storage, Base flow, Flood forecasting, Correlation analysis, Statistical methods.

Identifiers: USSR, Far East (USSR).

Rainfall regime of catchments were studied to make recommendations for computing the floodforming precipitation for areas of simultaneous runoff and determining losses of rain water. Depletion of the effective basin water-storage was investigated using mass material for the conditions typical for the south of the Far East of the USSR (mountain forested catchments, plain catchments, partially marsh-ridden catchments and permafrost regions). Observations at experimental stations and in the overall network served as a basis for working out the recommendations for computing the time of travel of surface and channel flood flow in various conditions of the south of the Far East. When hydrological data were absent or insufficient, calculations of the crest and the total volume of hydrographs of rain floods for small rivers were made on the basis of the pluvial input and runoff into the channel network as well as for the flow duration of this water to the gaging section. A comparison between the computed and the observed characteristics of the flood flow shows that their agreement is sufficient for the method to be used as a basis for designing hydraulic structures. (Knapp-W71-04414

TRANSFER FUNCTIONS FOR THE ANALYSIS OF RAINFALL-RUNOFF RELATIONS.

Technion-Israel Inst. of Tech., Haifa.

M. H. Diskin.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 962-971, 1969. 10 p, 3 fig, 4 ref.

*Rainfall-runoff Descriptors: relationships. *Mathematical studies, *Hydrograph analysis, *Unit hydrographs, Depth-area-duration analysis, Flood forecasting, Streamflow forecasting. Identifiers: Transfer functions.

Rainfall-runoff relations for watersheds are usually studied by means of the convolution integral. Considering the analogy between the watershed and a lumped input-output system, the three functions that appear in the integral are the output, the input, and the impulse response functions of the system. The convolution integral is strictly applicable only if the watershed system is linear; otherwise, it may be used only in an approximate way by assuming that the response functions varies from storm to storm but remains constant during any one storm. Non-linearity of watershed systems may be studied by changes in the form of the response functions. The process of deriving the shape of the response function from rainfall and runoff records is tedious and involves trial and error methods. It is possible however to study the properties of the response function from the properties of the transfer func-tion which is defined as the Laplace transform of the response function. In contrast to the complexity of deriving response functions, the transfer function is obtained directly from transforms of the output and input functions. The properties of transfer functions for watershed systems are discussed, and methods are given for obtaining these functions

and for their use for the analysis of rainfall-runoff relations. (Knapp-USGS) W71-04416

CALCULATION AND ANALYSIS OF THE WATER BALANCE USING DATA ON PRECIPITATION AND RIVER DISCHARGE, Institute for Geological and Geophysical Research, Belgrade (Yugoslavia).

J. Dzakovic.

Trans. From Vesnik Zavoda Za Geoloska Geofizicka Istrazivanua, Ser B, No 8, p 123-129, 1968. Available from NTIS as TT 68-50062. Bulletin of Engineering Geology and Hydrogeology, Ser B, No 8, p 111-116, 1968. 6 p, 1 fig, 1 tab, 5 ref.

Descriptors: *Water balance, *Hydrograph analy-*Recession curves, Streamflow forecasting, Discharge (Water), Precipitation (Atmospheric), Water storage, Groundwater Hydrogeology, Water level fluctuations. Identifiers: Groundwater balance. movement,

Water balance calculation for the catchment area of a river uses the method of resolving sources of the river hydrograph, supplemented by the recession method. Isolating the contribution made by groundwater to the total river discharge eliminates subjective estimation of this quantity and at the same time makes it possible to give a relatively ac-curate estimate of the change in groundwater reserves over the period of observation. Cumulative statistical analysis of the data gives information about the quantity of water stored on the surface. primarily in the form of snow and ice. This method of obtaining quantitative estimates of groundwater and surface water is convenient for application in regional hydrogeological investigations of little-studied catchment areas. (Knapp-USGS) W71-04610

THE ENERGY BALANCE CLIMATOLOGY OF A CITY-MAN SYSTEM,

California Univ., Los Angeles. Dept. of Geography.

Werner H. Terjung. Annals of the Association of American Geographers, Vol 60, No 3, September 1970, p 466-492. 29 fig, 6 tab.

Descriptors: *Climatology, *Weather modifica-tion, *Environment, Research and Development. Identifiers: *Energy balance, *Micro-climatology, Radiation, City-man system, Metropolitan Areas.

The urban energy balance climatology of the city and man in the Los Angeles basin was examined during a cloudy day ('Catalina eddy') in September 1968, from about sunrise to sunset, by measuring or estimating solar radiation, net radiation, ground heat flux, actual surface temperature, terrain radiant temperature, radiant sky temperature, and dry and wet-bulb temperature for the physical urban interface. An analagous theoretical model attempted to define the input of energy to the human interface via the solar heat load, and the disposal of human net radiation was shown via the channels of latent, sensible, and body heat flux. In spite of an apparent uniform cloud cover, the energy parameters has considerable areal variation in intensity and trend. During the daylight hours 70% of solar radiation was absorbed. An additional 32% was removed by longwave radiation. Of the net radiation received on the dry surface (47% of solar radiation), about 80% was disposed via sensible heat flux, and the remainder entered the pavement as storage. Air temperatures taken at shelter height were out of phase with the ongoing energy regime and were deemed of dubious value in urban climatic studies. Urban man received only 37% and 70% of the values available at the horizontal pavement for solar radiation and net radiation, respectively. A series of empirical and theoretical models show high correlations with the observations. It appeared that solar radiation and net radiation (physical and human) could have been estimated via the solar constant and appropriate transmissivities. (Wray-Chicago) W71-04753

2B. Precipitation

METEOROLOGICAL CAUSES OF RAINFALL FLOOD OCCURRENCES IN THE BASIN OF THE UPPER VISTULA, State Inst. of Hydrology and Meteorology, Warsaw

(Poland).

H. Mycielska. In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 859-866, 1969. 8 p, 8 fig, 13 ref.

Descriptors: *Rainfall-runoff relationships, analysis, *Meteorology, Synoptic forecasting, Isohyets, Hydrographs, Rainfall intensity, Streamflow forecasting, Storm runoff. Identifiers: Poland, Vistula River Basin.

Based on analysis of meteorological conditions of 21 rainfall floods that occurred in the basin of the Upper Vistula River in the years 1951-1960, an attempt was made to identify and characterize the types of synoptic conditions which led to floods. As a basis of the work rainfall periods with continuous rainfall were taken. Individual floods were occasionally caused by a few rainfall periods separated by intervals in which the rain stopped or distinctly decreased its intensity. Each rainfall period establishes an individual type of synoptic condition. An analysis of the meteorological conditions was made, then, for each of the above-mentioned periods. An isohyetal map obtained as a result of the study of synoptic conditions is presented. The aforesaid maps show the amount of water supply from the basin. In the case of rainfall floods, therefore, they are the basis for hydrological forecasts. Acquaintance with the genesis and development of individual types of synoptic conditions gives a better opportunity for forecasting flood rainfalls. (Knapp-USGS)
W71-04392

RADIATIVE COOLING AS A FUNCTION OF TEMPERATURE AND WATER VAPOR IN THE FREE ATMOSPHERE,

Colorado Univ., Boulder. Dept. of Astro-Geophysics; and National Center for Atmospheric Research, Boulder, Colo.
Julius London, and Takashi Sasamori.
Journal of Geophysical Research, Vol 75, No 33, p 6862-6863, November 20, 1970. 2 fig, 3 ref. NSF Grant GP-3196.

Descriptors: *Heat transfer, *Cooling, *Atmospheric_temperature, *Water vapor, *Climatology, Temperature.
Identifiers: *Radiative cooling, *Water-vapor distributions.

Some complexities in studies of atmospheric dynamics can be considerably simplified if suitable approximations are made in computations of radiative heating and cooling rates in the atmosphere. Radiative cooling in the troposphere, in the absence of clouds, depends largely on the vertical distribution of temperature and water vapor. It has been suggested, however, that a good first approximation to the radiative cooling distribution would be a linear dependence on the local free-air temperature. This paper reports the results of some calculations of radiative flux divergence in model atmosphere to test such an approximation. Radiative cooling in a clear atmosphere for winter and summer seasons at different latitudes of the northern and sourthern hemispheres is completed. The models were based on observed mean temperature distributions up to 25 mb and observed water vapor distributions up to 500 mb. The computed standard error of estimate as a measure of the variation of the calculated cooling rate about the regression line S sub c were about plus or minus 0.33C/day when the corresponding water-vapor distribution for each latitude and season was used. This was reduced to plus or minus 0.16C/day when a single water-vapor distribution was assumed. This indicates that a better approximation for the cooling rate could be obtained by use of multiple

Streamflow and Runoff—Group 2E

regression involving both temperature and water distributions. (Herreran Vanderbilt) W71-04433

TEMPORAL DISTRIBUTIONS OF RADIOAC-TIVITY AND Sr-89/Sr-90 RATIOS DURING RAINSTORMS, Arkansas Univ., Fayetteville. Dept. of Chemistry.

J. R. Noyce, T. S. Chen, D. T. Moore, J. N. Beck. and P. K. Kuroda.

Journal of Geogphysical Research, Vol 76, No 3, p 646-656, January 20, 1971. 11 p, 6 fig, 2 tab, 24 ref. USAEC Contract At- (40-1)-2529.

Descriptors: *Fallout, *Radioisotopes, *Rainfall, Clouds, Precipitation (Atmospheric), Cloud physics, Atmospheric physics, Meteorology, Air circulation, Climatology.
Identifiers: *Stratospheric circulation.

Radionuclide concentrations for Sr-89, Sr-90, Ce-144, and Cs-137 were sequentially sampled from two rainstorms to study fallout behavior as a function of rainfall rate and type of storm approximately 7 months after the eighth Chinese nuclear explosion of December 27, 1968. Great time variability in the Sr-89/Sr-90 ratio was found in conjunction with a well-developed storm on July 21, but a nearly steady ratio was observed in a stratified stable-type storm on August 14. Tapping of stratospheric air appeared to be the cause of the ratio changes. For both storms, a strong trend was found for concentrations of radioisotopes to decrease with increase in rainfall rate. Detailed discussions on meteorological factors, including a dilution effect, are given to interpret the experimental data. (Knapp-USGS)
W71-04563

FORMATION AND GROWTH OF ICE FOG PARTICLES AT FAIRBANKS, ALASKA, Air Force Cambridge Research Lab., Bedford,

Mass.; and Alaska Univ., College. Geophysical Inst. For primary bibliographic entry see Field 02C. W71-04564

INVESTIGATION OF STORM PRECIPITATION PATTERNS OF THE LOS ANGELES RIVER AND SAN GABRIEL RIVER DRAINAGE BASINS AND THE SHIFTS IN THE NATURAL PRECIPITATION PATTERN PRODUCED BY ARTIFICIAL NUCLEATION.

North American Weather Consultants, Goleta,

For primary bibliographic entry see Field 03B. W71-04681

EFFECT OF COOLING TOWER EFFLUENTS ON ATMOSPHERIC CONDITIONS IN NORTHEASTERN ILLINOIS, PRELIMINARY REPORT,

Illinois State Water Survey, Urbana. For primary bibliographic entry see Field 06G. W71-04682

2C. Snow, Ice, and Frost

A REVIEW OF WATER RESOURCES OF THE UMIAT AREA, NORTHERN ALASKA, Geological Survey, Washington, D.C.

John R. Williams.

Geological Survey Circular 636, 1970. 8 p, 2 fig, 2

Descriptors: *Water resources, *Alaska, *Surface waters, *Groundwater, *Water quality, Stream-flow, Seasonal, Ice, Permafrost, Frozen soils, Frozen ground, Aquifers, Water yield, Hydrologic data, Groundwater movement, Alluvium, Hydrology, Springs, Storage, Recharge. Identifiers: *Umiat area (Northern Alaska).

In the Umiat area of northern Alaska, surfacewater supplied from the Colville River, small tributary creeks, and lakes are abundant in summer but limited in winter by low or zero flow in streams and thick ice cover on lakes. Fresh groundwater occurs in unfrozen zones in alluvium and in the upper part of bedrock beneath the Colville River and beneath lakes that do not freeze to the bottom in winter. Brackish or saline groundwater occurs in bedrock beneath as much as 1,055 feet of permafrost in the Arctic foothills and beneath 750 to 800 feet of permfrost beneath low terraces of the Colville River valley. The foothill area is unfavorable for developing supplies of potable groundwater because of the great depth to water, predominance of brackish or saline water, and low potential yield of the bedrock. In the Colville River valley, shallow unfrozen alluvium beneath the river and deep lakes will yield abundant year-round supplies of groundwater, but the bedrock below permafrost yields less than 10 gallons per minute of saline or brackish water. (Woodard-USGS) W71-04364

AREAL MEASUREMENTS OF WATER EQUIVALENT OF SNOW DEPOSITS BY MEANS OF NATURAL RADIOACTIVITY IN THE GROUND,

Institutt for Atomenergi, Kjeller (Norway); and Norwegian Water Resources and Electricity Board,

J. B. Dahl, and H. Odegaard.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/13, p 191-212, 1970. 22 p, 9 fig,

Descriptors: *Snow surveys, *Nuclear moisture meters, *Water equivalent, *Gamma rays, Snow cover, Water yield, Snowpacks, Calibrations, Snow management, Runoff forecasting, Streamflow

forecasting.
Identifiers: *Norway, *Nuclear water-equivalent meters (Snow).

Gamma rays emitted from naturally occurring radioactive elements in the ground are used to measure continuously the water equivalent of snow deposits along selected routes in typical mountain and lowland areas in Norway. The activity measurements have been made from snow scooters and from helicopters flying about 5 and 20 m above ground level. Snow deposits equivalent to 0 - 30 cm of water are measured with an accuracy better than 10% standard deviation as compared with a series of conventional gravimetric measurements. The method is to be applicable to measurements of snow deposits equivalent to 0 - 60 cm of water. An empirical formula is given for computer calculation of snow deposits by this method. The formula is valid for measurements of snow deposits through the winter season. (Knapp-USGS) W71-04374

RADIOACTIVE TRACING IN FROZEN RIVERS.

Ceskoslovenska Akademie Ved, Prague. Inst. of Hydrodynamics; Ceskoslovenska Akademie Ved, Prague. Ustav Jaderneho Vyskumn; and Prague. Hydrometeorologicky Ustav, Ostrava

zechoslovakia).

J. Balek, J. Ralkova, and R. Sochorec.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/28, p 479-482, 1970. 4 p, 2 fig, 3

Descriptors: *Tracers, *Radioisotopes, *Chromium, *Discharge measurement, *Ice, Streamflow, Stream gages, Velocity, Regime, Discharge (Water), Mixing, Radioactivity techniques. Identifiers: *Iced rivers.

Time of travel and discharge measurements were made in frozen rivers by means of radioactive tracing. The measurements were made with Cr-51 in two frozen rivers of north Moravia. Czechoslovakia, in 1969. The application of the isotope technique on the time of travel measurement in frozen rivers was considered to be a satisfactory method. The movement of water particles was found to be faster in a channel covered by ice than in a free surface channel when other hydraulic conditions remained unchanged. (Knapp-USGS) W71-04382

SPRING FLOOD HYDROGRAPH COMPUTA-TION ON THE BASIS OF DATA ON INFLOW TO THE WATERSHED SURFACE AND INTO THE RIVER SYSTEM,
Gidrometeorologicheskii Nauchno-Issledovatelskii

Tsentr, Moscow (USSR).

For primary bibliographic entry see Field 04A. W71-04406

FORMATION AND GROWTH OF ICE FOG

PARTICLES AT FAIRBANKS, ALASKA, Air Force Cambridge Research Lab., Bedford, Mass.; and Alaska Univ., College. Geophysical Inst. P. J. Huffman, and T. Ohtake.

Journal of Geophysical Research, Vol 76, No 3, p 657-665, January 20, 1971. 9 p, 5 fig, 15 ref. HEW-NCAPC Grant AP 0049.

Descriptors: *Fog, *Freezing, *Nucleation, *Cooling, *Ice, Alaska, Crystal growth, Cloud physics, Meteorology, Aerosols, Particle size. Identifiers: *Ice fog.

A mechanism is proposed for the formation of ice fog particles in the city and environs of Fairbanks, Alaska. Equations are developed for calculating the size distribution resulting from growth by deposition of water vapor. The equations are numerically solved with a computer for three major types of ice fog sources: (1) automobile exhaust, (2) exhaust from heating plants, and (3) open water. The size distribution produced by an in-dividual source is determined by the cooling of water vapor injected into the environment. The cooling rate is a function of the source characteristics and the ambient temperature. The proposed mechanism adequately represents the observed size distribution if the cooling rate of the water vapor injected into the environment is not too large (source types 2 and 3). Because of the large cooling rate of the water vapor injected into the atmosphere by source type 1, the size distribution from this source is not adequately represented by the model. In agreement with observations, the computational results predict a decrease in the size of ice fog particles with decreasing ambient temperature for source types 2 and 3. (Knapp-USGS) W71-04564

2E. Streamflow and Runoff

TRITIUM AND OXYGEN-18 IN NATURAL WATER SAMPLES FROM SWITZERLAND,

Bern Univ. (Switzerland); and Pisa Univ. (Italy). U. Siegenthaler, H. Oeschger, and E. Tongiorgi. In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No Sm-129/22, p 373-385, 1970. 13 p, 10 fig, 16 ref.

Descriptors: *Tritium, *Oxygen, *Hydrogeology, *Radioactive dating, Groundwater movement, Recharge, Discharge (Water), Water balance, Precipitation (Atmospheric), Altitude, Mountains, Lakes, Streamflow, Water sources, Mixing, Surface-groundwater relationships. Identifiers: *Switzerland, *Alps, *Oxygen isotopes.

Field 02-WATER CYCLE

Group 2E—Streamflow and Runoff

Tritium and O-18 concentrations were measured in precipitation samples at various stations in the Alps, in the foothills of the Alps and the Jura region. Mean O-18 concentration and mean annual temperature follow a linear relationship at many, but not all, of the considered stations. The O-18 to altitude relationship varies between different regions. The O-18 and tritium contents in precipita-tion are used as a basis for interpreting the T/Hand O-18/O-16 ratios observed in rivers and underground waters. A spring in the Alps shows no seasonal variations in either tritium or O-18. O-18 provides information about the mean altitude of its recharge area whereas tritium values allow the computation of the mean residence time of the water in the ground. The isotopic behavior of different inputs (precipitation, lake and river water) to the groundwater downstream from the lake of Thun was investigated. Distinct tritium variations occur with a sharp maximum in winter. This cannot be due to delayed rain from the preceding summer, since O-18 is constant with time. The variations can be explained by assuming several well-mixed reservoirs of different ages with a mixing ratio varying with time. The isotopic compositions of the considered underground waters support the assumption that groundwater recharge occurs uniformly during all seasons. (Knapp-USGS) W71-04379

STABLE CARBON AND OXYGEN ISOTOPES OF NATURAL WATERS IN THE NETHER-LANDS,

Groningen Rijksuniversiteit (Netherlands). For primary bibliographic entry see Field 02F. W71-04380

MEASUREMENT OF VARIABLE FLOW PAT-TERNS BY A METHOD INVOLVING DILUTION OF RADIOACTIVE TRACERS (FRENCH), Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires. For primary bibliographic entry see Field 08B. W71-04383

THE CONCEPT OF 'GOOD MIXING' IN THE USE OF TRACERS: DISCHARGE VELOCITY AND VELOCITY OF THE CENTER OF GRAVI-TY OF A TRACER CLOUD IN FLOW STUDIES (FRENCH),

Toulouse Univ. (France). Institut de Mecanique des Fluides; and Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

For primary bibliographic entry see Field 08B.

PEAK DISCHARGE AND TIME OF CONCENTRATION RELATION TO RAIN INTENSITY INVESTIGATED BY PHYSICAL MODELS OF WATERSHEDS.

Prague Agricultural Univ. (Czechoslovakia) For primary hibliographic entry see Field 02A. W71-04388

APPLICATION OF PROBABILITY TO SPILL-WAY DESIGN FLOOD ESTIMATION.

State Rivers and Water Supply Commission, Melbourne (Australia). For primary bibliographic entry see Field 08B. W71-04389

THE FLOOD FORECASTING BY A SERIES STORAGE TYPE MODEL,

National Research Center for Disaster Prevention, Tokyo (Japan)

For primary bibliographic entry see Field 02A. W71-04390

THE RELATIONSHIP BETWEEN LAG TIME AND THE PHYSICAL CHARACTERISTICS OF DRAINAGE BASINS IN SOUTHERN ONTARIO, Queen's Univ., Kingston (Ontario).

R. J. Kennedy, and W. E. Watt.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 866-874, 1969. 9 p, 3 fig, 2 tab, 4 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff forecasting, *Peak discharge, *Routing, *Recession curves, Time lag, Effective precipitation, Hydrographs, Precipitation excess, Hydrograph analysis, Statistical methods, Regression

Identifiers: Ontario, Canada.

Part of the Canadian IHD Programme was intended to develop a standard method of computing the peak rate of runoff corresponding to a selected probability, for drainage basins in the area range of ten to one hundred and fifty square miles. The physical factors thought to have a major effect on the lag time, here defined as the time interval from the midpoint of the excess rain to the center of gravity of runoff, were combined into an equation. Records of a number of isolated storms from each of a dozen drainage basins were analyzed and the actual lag times compared with those indicated by the equation. The final equation, with exponents adjusted, gives lag time in terms of area, shape factor, equivalent slope, storage factor and population factor. (Knapp-USGS) W71-04391

THE SIGNIFICANCE OF CHARACTERISTICS OF BASIN RAINFALL AND MORPHOMETRY A STUDY OF FLOODS IN THE UNITED KINGDOM,

Hydrological Research Unit, Wallingford (En-

For primary bibliographic entry see Field 02A. W71-04393

MEAN DISCHARGE AS AN INDEX TO MEAN MAXIMUM DISCHARGE, EIE Dept., Ankara (Turkey).

H. Conturk.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 826-833, 1969. 8 p, 2 fig, 1 tab, 13 ref.

Descriptors: *Streamflow, *Discharge (Water), *Stream gages, *Estimating, *Statistical methods, Data collections, Hydrologic data, Regimen, River forecasting, Rainfall-Runoff relationships.

Identifiers: Mean annual flood, Mean discharge,

In Turkey, where a variety of climates and physiographic features exists, a network of stream-gaging stations is not yet developed to give a good picture of changes in streamflow, especially of maximum discharges, both in time and space. An attempt is made to approximate mean maximum discharges using average streamflow discharges as an index. The ratio of the mean maximum discharge to average discharge at long-term stations shows a regional variation, almost independent of the size of drainage area. Accordingly, at points, gaged or ungaged, for which recorded or estimated average discharges are available, mean maximum discharge can be estimated. (Knapp-USGS) W71-04394

THE INFLUENCE OF RESERVOIR STORAGE ON STATISTICAL PEAK FLOWS, Institut fuer Wasserwirtschaft, Berlin (East Ger-

many) For primary bibliographic entry see Field 04A.

W71-04395

CHANGE OF RUNOFF DUE TO URBANIZA-TION,

Public Works Research Inst., Tokoyo (Japan). For primary bibliographic entry see Field 04C. W71-04399

INFLUENCE OF SOILS, VEGETATION AND GEOMORPHOLOGY ON ELEMENTS OF THE FLOOD HYDROGRAPH,

Agricultural Research Service, Beltsville, Md. Hydrograph Lab.

For primary bibliographic entry see Field 04A. W71-04402

FLOOD PLAIN INFLUENCE ON FLOOD WAVE PROPAGATION ALONG A RIVER, State Hydrological Inst., Leningrad (USSR).

M. S. Grushevsky.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Wnesco-WMO), p 745-754, 1969. 10 p, 4 fig, 1 tab, 10 ref.

Descriptors: *Discharge (Water), *Floods, *Streamflow, *Routing, *Model studies, Mathematical models, Hydraulic models, Hydrographs, Peak discharge, Unsteady flow, Streamflow forecasting, Flood forecasting, Floods, Flood plains.

Identifiers: Flood wave propagation, USSR.

The decrease of maximum discharge and the change of hydrograph shape along a river as well as the propagation rate of wave crest and its relation to mean flow velocity were calculated on the basis of field observations on artificial flood wave propagation on the Tvertza River and spring flood on the Irtysh River, USSR. Comparison of these characteristics along the river reaches with and without a flood plain permits investigation of the flood plain influence. The influence of a flood plain on unsteady flow is being investigated in greater detail by means of numerical experiments on hypothetic models of simple channels with flood plains. (Knapp-USGS) W71-04403

DESIGN HYDROGRAPHS OF SPRING FLOODS AND METHODS OF THEIR COMPUTATION (BASED ON BYELORUSSIAN RIVER OBSER-VATIONS),

Politekhnicheskii Institut, Minsk Belorusskii (USSR); and Ministry of Land Reclamation and Water Economics, Minsk (USSR).

M. G. Krasnik, I. M. Livshitz, V. F. Shebecko, and E. A. Bragilevskaya.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 727-735, 1969. 9 p, 4 fig, 3 tab, 2 ref.

*Hydrograph analysis, *Flood forecasting, Snowmelt, Design flood, Flood control, Frequency analysis, Model studies, Mathematical models, Runoff, Discharge (Water), Streamflow forecasting. Identifiers: Byelorussia, USSR.

Flood control on rivers having an appreciable rate of spring flood runoff should be based on design flood hydrographs. In order to generalize snowmelt runoff of Byelorussian rivers, hydrological data of 60 gaging stations from catchments ranging from 70 to 36,000 sq km, of which 4-55% was swampy, for periods from 15 to 70 years were used. The analysis of typical hydrographs and adequate nondimensional models showed a number of features of their formation specific to the area investigated. The generalized hydrographs are recommended for use when estimating unstudied rivers. (Knapp-USGS) W71-04404

THE ESTIMATION OF RUNOFF OF LARGE AND MEDIUM RIVERS PROCEEDING FROM THE RUNOFF OF MINOR RIVERS, State Hydrological Inst., Leningrad (USSR).

For primary bibliographic entry see Field 04A. W71-04407

Streamflow and Runoff--Group 2E

CALCULATION OF FLOOD DISCHARGES BY MEANS OF THE UNIT HYDROGRAPH,

Ukrainskii Nauchno-Issledovatelskii Gidrometeorologicheskii Institut, Kiev (USSR). For primary bibliographic entry see Field 04A.

A SYSTEMS ANALYSIS OF THE LOWER GANGES-BRAHMAPUTRA BASIN.

Harvard Univ., Cambridge, Mass.

Peter Rogers.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 894-909, 1969. 16 p, 3 fig, 4 tab, 8 ref.

Descriptors: *Systems analysis, *River basin development, *Flood control, *Optimum development plans, *Water resources development, Water supply, Recreation, Saline water intrusion, River training, Irrigation, Navigation, Hydroelectric power, Water storage, Reservoir design. Identifiers: India, Pakistan.

The Lower Ganges and the Brahmaputra join together in the Province of East Pakistan to form one of the major river systems in the world. Each year the rivers flood during the monsoon causing loss of lives and great damage to crops and property. The problem of controlling these floods should not be considered alone but should be viewed in the context of the river system as a whole. The number of possible combinations of structural and non-structural variables for this system is so large that conventional methods of analysis are inadequate. By use of Systems Analysis techniques a rational plan to control the floods may be made while taking advantage of the complementarities which exist with other possible uses for the river. In this way the production of hydropower, irrigation during the dry months of the year, provision of adequate flow for year round navigation, and the control of saline intrusion at the delta may be integrated into the flood control system by means of surface water and groundwater storage, and river training works. (Knapp-USGS) W71-04410

INFLUENCE OF UPPER INDUS BASIN ON THE ELEMENTS OF THE FLOOD HYDROGRAPH AT TARBELA-ATTOCK,

Pakistan Irrigation and Power Dept., Lahore.

Mohiuddin Khan.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 918-925, 1969. 8 p, 5 ref, 3 append.

Descriptors: *Floods, *Hydrographs, *Regime, *Rainfall-runoff relationships, *Rivers, Geomorphology, Topography, Mountains, Landslides, Glaciers, Snowmelt, Storm runoff.
Identifiers: Indus River, India.

The Indus river rises in the Tibetan Plateau at elevations above 18,000 feet. Upon leaving Tibet, it follows a tectonic trough and flows northwesterly until it reaches Nanga Parbat where it begins to flow south. The river is steep and runs in a narrow gorge. There are no lakes or large forests on this river. About one quarter of the area is occupied by snow fields and glaciers. The main rock types are sedimentary. The narrow valleys of Himalayan rivers subjected to seismic movements have a risk of floods caused by earthslides and rockslides. Glaciers are also known to block the streams. Hydrographs due to snowmelt floods show a gradual rise and fall. Those due to bursting of glacier dams, landslide dams, and heavy rains are prominent by their steep rise and fall. Bursting of landslide dams produce the most severe floods. The rain floods are smaller as the basin is subject to monsoon rains in only 10% catchment. (Knapp-USGS) W71-04412

STAGE AND FREQUENCY OF FLOODS IN CENTRAL INDIA,

Ministry of Railways, Lucknow (India),

A. Bhatnagar.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publica-tion No 85 (Unesco-WMO), p 925-932, 1969. 8 p, 5 fig. 4 ref.

Descriptors: *Stage-discharge relations, *Frequency analysis, *Floods, *Flood forecasting, *Peak discharge, Statistical methods, Data collections. Identifiers: India.

Annual flood stages at 20 railway bridges with catchment areas varying from 800 sq km to 29,000 sq km in Central India were analyzed to evolve regional stage-frequency relations. A dimensionless regional frequency curve was evolved correlating annual flood stages expressed as a ratio to mean annual flood stage along with the relation of mean annual stage to catchment area. With the help of these two curves momentary peak flood stage for any design frequency can be determined for any catchment in this region. From the second curve the mean annual stage corresponding to the catchment area is determined. This, when multiplied by the ratio of the annual flood stage to the mean annual flood stage for the design frequency, obtained from the first curve, gives the required annual flood stage. (Knapp-USGS) W71-04413

CONDITIONS LEADING TO THE FORMATION OF RAIN FLOOD FLOW ON SMALL RIVERS IN THE SOUTHERN PART OF THE FAR EAST, Far Eastern Hydrometeorological Research Inst.,

Vladivostok (USSR). For primary bibliographic entry see Field 02A. W71-04414

DISPERSION CHARACTERISTICS OF THE COLUMBIA RIVER BETWEEN RIVER MILES 383 AND 355,

Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.

J. C. Sonnichsen, Jr., D. A. Kottwitz, and R. T. Jaske.

Battelle Memorial Institute, Pacific Northwest Lab Report, BNWL-1477, October 1970. 32 p, 8 fig, 4

Descriptors: *Dispersion, *Eddies, Turbulence, Turbulent flow, Tracers, Mixing, Temperature, Dye releases.

Identifiers: *Columbia River, *Eddy Diffusion coefficients, *Longitudinal and Lateral diffusion, Effluent buoyancy.

The area of the Columbia River between miles 383 and 355 has been used by the Atomic Energy Commission and no less than five plutonium-producing and power-producing reactor complexes have been sited on these waters. The purpose of this report is to determine the lateral and longitudinal eddy diffusion coefficients for this section of the river. The techniques employed include both remote sensing systems and physical contact sampling systems. Dye is used as a tracer in both techniques. An empirical examination of the effect of affluent buoyancy on the lateral dispersion coefficient is presented. Results indicate that the lateral diffusion coefficient depends upon density differentials. Values for the longitudinal diffusion coefficient generally range between 500 sq ft./sec and 3000 sq ft./sec for flow rates of 80,000 to 130,000 cu ft./sec. (Herrera-Vanderbilt) W71-04444

WATER SURFACE CONFIGURATION

CHANNEL BENDS, Howard Univ., Washington, D.C. Dept. of Civil Engineering; and Illinois Univ., Urbana. Dept. of Civil

Engineering. Chin-lien Yen, and Ben Chie Yen.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY2, Paper 7928, p 303-321, February 1971. 19 p, 8 fig, 9 ref, append.

Descriptors: *Open channel flow, *Flow profiles, *Meanders, *Channel morphology, Hydraulics, River training, Mathematical studies, Reynolds number, Turbulent flow, Steady flow, Water levels.

Water surface configuration in open-channel bends depends on the geometry of the channel. Mathematical expressions for longitudinal and transverse water surface profiles are derived from the equations of motion with the aid of order of magnitude analysis. Computed surface profiles and superelevation obtained by using mathematical expressions agree well with experimental measurements of subcritical flows in trapezoidal and natural bed meandering models. The result reveals that the channel bed topography is an important factor in determining the superelevation and water surface profiles. Inadequacy of conventional approximate methods to evaluate the superelevation is also examined. (Knapp-USGS) W71-04575

THEORETICAL PROBABILITY DISTRIBU-

TIONS FOR FLOOD PEAKS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering. For primary bibliographic entry see Field 04A. W71-04590

FLOW MEASUREMENTS IN THE DANUBE,

Vienna Univ. (Austria). Institut fuer Radium-forschung und Kernphysik; and Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna.

P. Gehringer, L. Riedlmayer, and H. Rotzer.
In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/29, p 483-496, 1970. 14 p, 7 fig, 3 tab, 7 ref.

Descriptors: *Tracers, *Tracking techniques, *Discharge measurement, *Stream gages, Navigation, Water levels, Stage-discharge relations, Water level fluctuations, Velocity, Current meters, Mix-Radioactivity Dispersion, ing, techniques. Sampling. Identifiers: *Bromine radioisotopes, *Danube

The measurement of flow rate in rivers which may undergo marked seasonal changes in depth is highly important both for navigation and for the operation of hydraulic power plants. Nuclear methods, which are known to give very good results in smaller rivers, were applied to larger streams. By contract of the company operating a chain of power stations along the Austrian part of the Danube, dispersion and flow rate measurements with radioactive tracers were carried out in the reach between Aschach and Linz. In this zone, flow rates between 1000 and 7000 cu m/sec may be expected. A combined method of total count and total sample was applied using Br-32 as the tracer. Samples as well as direct measurements were taken simultaneously at various depths from three boats across the river. (Knapp-USGS)
W71-04591

NUCLEAR TECHNIQUES IN STUDIES OF DISPERSION AND SOME OTHER PROPER-TIES OF THE DANUBE, Institut za Nuklearne Nauke Boris Kidric, Belgrade

(Yugoslavia); and Institut za V Jaroslav Cerni, Belgrade (Yugoslavia). Vodoprivredu

Jarosav Cerin, Bergraude (1 ugoslavia).
T. Tasovac, R. Draskovic, R. Radosavljevic, A.
Filip, and V. Vukmirovic.
In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255,

Field 02—WATER CYCLE

Group 2E—Streamflow and Runoff

Paper No SM-129/30, p 497-507, 1970. 11 p, 7 fig, 3 tab, 7 ref.

Descriptors: *Tracers, *Path of pollutants, *Mixing, Diffusion, Dispersion, Discharge measurement, Trace elements, Industrial wastes, Radioactive wastes, Radioecology, Water pollution effects, Water pollution sources, Suspended load, Water

Identifiers: *Danube River.

Systematic tracer investigations of the Danube were made to determine the changes in hydrodynamic, hydrochemical and hydrobiotical properties of the river and to determine increased accumulation of waste material. Radioactive tracers were used to study the dispersion characteristics of the river in different hydrological conditions within the experimental zone of twenty-five kilometers. The properties of the water and suspended material were investigated by neutron activation analysis, and the accumulation of radioactive pollutants in different components of the ecosystem were also studied. Vertical mixing was attained after two kilometers and lateral distribution of radioactive tracer was still not complete eighteen kilometers downstream from the injection point. Twelve kilometers downstream from the injection point, the diffusion coefficients reach a constant value. The maximum concentrations of injected radioactive tracer decrease exponentially along the river course. Radioecological studies by gamma spectrometry show that, in addition to fallout activity, gamma emitting nuclides characteristic of corrosion products are present. (Knapp-USGS) W71-04592

HYDRAULIC PROPERTIES RELATED TO STREAM REAERATION,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 05G.
W71-04593

APPLICABILITY OF **SHORT-MEMORY** MODES TO ENGLISH RIVER-FLOW DATA, Birmingham Univ. (England). For primary bibliographic entry see Field 06A.

2F. Groundwater

W71-04770

MECHANICAL COMPACTION OF SANDS CONTAINING DIFFERENT PERCENTAGES OF DUCTILE GRAINS: A THEORETICAL AP-PROACH,

Shell Oil Co., Houston, Tex.

Gordon Rittenhouse.

American Association of Petroleum Geologists Bulletin, Vol 55, No 1, p 92-96, January 1971. 5 p,

Descriptors: *Porosity, *Pores, *Interstices, *Diagenesis, *Ductility, Compressibility, Plasticity, Sandstones, Permeability, Groundwater move-ment, Porous media, Void ratio, Voids, Solubility, Sediments, Sedimentary petrology, Sedimentary

Identifiers: Pore-space, Cementation, Compaction.

The reduction in pore space and thickness caused by plastic deformation of grains has been calculated for different proportions of ductile and nonductile, uniformly sized spheres in orthorhombic packing and for other shapes of grains. The relation for uniformly sized spheres in orthorhombic packing is believed to be applicable to well-sorted and rounded natural sands in which compaction has been extensive, and to be a maximum for angular sands or for very well-sorted and extremely well-sorted, well-rounded sands. Applicability to less well-sorted sands is less certain. In sands in which such plastic deformation has not been complete, less reduction in pore space or thickness

may be expected. These relations may be helpful in separating the effects of plastic deformation of grains from those caused by grain rotation of fracturing, solution from points of grain contact, and cementation. Experimental investigation of the relation of ductile grain content to reduction in pore space or thickness is considered desirable. (K-napp-USGS) W71-04360

PORE-SPACE REDUCTION BY SOLUTION AND CEMENTATION, Shell Oil Co., Houston, Tex.

Gordon Rittenhouse.

American Association of Petroleum Geologists Bulletin, Vol 55, No 1, p 80-91, January 1971. 12 p, 9 fig, 9 ref, append.

Descriptors: *Porosity, *Pores, *Interstices, *Diagenesia, *Sandstones, Permeability, Groundwater movement, Porous media, Void ratio, Voids, Solubility, Sediments, Sedimentary petrology, Sedimentary rocks.

Identifiers: Pore-space, Cementation, Compaction.

The amount of pore-space reduction caused by solution of grains at points of contact and the additional reduction that would result from precipitation of this dissolved material was investigated. For single grains and their associated pore space such reduction in porosity was calculated for spheres and other geometric forms in various packing arrangements. The relative amounts of porosity reduction may vary greatly, depending on grain shape and angularity, packing, direction of pressure, and amount of solution. The maximum porosity loss by cement relative to porosity loss by solution occurred with spheres in orthorhombic packing, rotated 30 deg. This is believed to be a maximum for any sand and most closely ap-proached by a well-sorted sandstone made up of very well-rounded grains. A maximum cement-tosolution relation is estimated for sandstones of better or poorer sorting or greater grain angularity. The extrapolation from single grains and their associated pores to sandstones is complicated by the possibility of nonuniform solution or cementation. (Knapp-USGS)
W71-04361

RELIABILITY OF CARBON-14 DATING OF GROUNDWATER: EFFECT OF CARBONATE EXCHANGE, Heidelberg Univ. (West Germany).

L. Thilo, and K. O. Munnich.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No Sm-129/17, p 259-270, 1970. 12 p, 7 fig, 1 tab, 8 ref. IAEC Contract 215/RB.

Descriptors: *Carbon radioisotopes, *Radioactive dating, *Groundwater movement, *Ion exchange, Carbonates, Carbonate rocks, Soil chemistry, Water chemistry, Leaching, Limestones, Recharge, Discharge (Water), Water circulation, Carbon dioxide, Mixing, Tritium.

Identifiers: *Radiocarbon dating (Groundwater),

Groundwater dating.

Carbonate exchange was investigated by measuring the flow of a C-14 spiked carbonate solution through columns of a number of different calcareous materials. A reversible exchange was clearly observed by a delay of the C-14 tracer compared with the carrier solution. The extent of this delay amounts to an exchange which is restricted to amounts to an exchange which is restricted to somewhat less than one molecular layer on the surface of the solid phase. The exchange time is less than about 2 hours. The influence of such an exchange on the C-14 dating of groundwater is limited and can be estimated fairly accurately if the grain size and the relative carbonate concentrations of the aquifer are known. An additional irreversible carbonate exchange was shown by larger and permanent losses of C-14 from the liquid

phase, especially at higher temperatures. The temperature dependence for this process was measured and, when extrapolated, pointed to significant losses of C-14 at 10 deg C within time intervals comparable to the lifetime of C-14. A comparison between the concentration of bomb-produced C-14 in the atmosphere with the concentration that subsequently appears in a shallow aquifer, showed no clear evidence of carbonate exchange. (Knapp-USGS) W71-04372

CARBON-14 DATING OF GROUNDWATER,

Council for Scientific and Industrial Research, Pretoria (South Africa). National Physics Research

J. C. Vogel.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/15, p 225-239, 1970. 15 p, 6 fig, 2 tab, 13 ref.

Descriptors: *Carbon radioisotopes, *Deuterium, *Tritium, *Groundwater movement, *Radioactive dating, Groundwater, Soil water, Recharge, Discharge (Water), Water chemistry, Carbonates, Water circulation, Leaching, Carbon dioxide, Mix-

Identifiers: *Groundwater dating, *Radiocarbon dating (Groundwater).

The expected age distribution of water in different types of aquifers with primary and secondary permeability is discussed and examples given. Remarkably uniform flow is sometimes observed over distances of several kilometers with secondary permeability, and average flow rates can be deduced even where the strata are too heterogeneous to apply pumping tests. The apparent age of spring water emerging from an unconfined aquifer, as calculated from the C-14 or tritium contents, can be used to calculate the average age of the water in the aquifer and thence the rate of recharge and storage capacity. Such apparent ages provide a means of directly comparing tritium and C-14 data. The initial C-14 content of groundwater is found to be about 85% of the modern value in both humid and arid climatic regions. The magitude of a possible loss of C-14 from the groundwater by isotope exchange with solid carbonate appears to be relatively small in practice and C-14 ages are probably no more than 20 to 30% too high, even under unfavorable conditions. (Knapp-USGS) W71-04373

TECHNIQUES APPLIED ATER MOVEMENT IN ISOTOPE GROUNDWATER THE KONYA PLAIN, State Hydraulic Works, Ankara (Turkey)

For primary bibliographic entry see Field 04B. W71-04375

CARBON-14 CONCENTRATION OF LIME IN SOILS AND ASPECTS OF THE CARBON-14 DATING OF GROUNDWATER,

Niedersaechsisches Landesamt Bodenforschung, Hanover (West Germany). For primary bibliographic entry see Field 02G. W71-04376

SEQUENTIAL SAMPLING OF RADIOCARBON

IN GROUNDWATER, Instituto Venezolano de Investigaciones Cientificas, Caracas; and Soil Science Inst., Bonn (West Germany).

M. A. Tamers, and H. W. Scharpenseel.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255/16, p 241-257, 1970. 17 p, 7 fig, 3 tab, 21 ref.

Groundwater—Group 2F

Descriptors: *Carbon radioisotopes, *Tritium, *Radioactive dating, *Groundwater movement, Limestones, Carbonates, Leaching, Recharge, Discharge (Water), Groundwater, Water chemis-try, Carbonate rocks, Water circulation, Carbondioxide, Mixing.

Identifiers: *Radiocarbon dating (Groundwater). Groundwater dating.

artificial variations in atmospheric radiocarbon contents are used in the evaluation of flow velocities in young groundwater systems. Exact age determinations are possible if a periodic sampling program is established. The changing radiocarbon concentrations of the groundwater carbonate species, after correction for limestone dilution, can be fitted to known excesses in plants over the past two decades. Three aquifers have been studied by this technique. Four annual samplings are shown for the Lake of Valencia and for Barquisimeto groundwaters in Venezuela, and three samplings for the Koln 07 system in the Federal Republic of Germany. The best fit is obtained for Barquisimeto, where groups of data from seven wells along the aquifer axis were used in the calculation of a flow velocity of 100 meters per year. The well closest to the outcrop produces water with an apparent age of 3.5 years and the last well, 10.5 years. Tritium contents, which were measured in the Koln 07 series, are not in good agreement with the radiocarbon values. (Kanpp-USGS) W71-04377

CONTRIBUTION OF ENVIRONMENTAL MEASUREMENTS TO TRITIUM GEOHYDROLOGICAL PROBLEMS

SOUTHERN AFRICA, University of the Witwatersrand, Johannesburg (South Africa); Botswana Geological Survey, Lohatse

B. Th. Verhagen, J. P. F. Sellschop, and C. M. H. Jennings.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No Sm-129/58, p 289-313, 1970. 25 p, 9 fig, 7 tab, 13 ref.

Descriptors: *Tritium, *Groundwater movement, Aquifers, Hydrogeology, Tracers, Tracking techniques, Radioactive dating, Sampling, Water wells, Water balance, Climates, Weather, Recharge, Discharge (Water), Water yield. Identifiers: *Botswana

In Lobatsi and Serowe, Botswana, measurements of environmental tritium content are compared with geohydrological features as determined by conventional methods. A confined and simple aquifer is under study, to act as a test bench for the interpretation of results on a large scale. The concentrations encountered are generally very low (0-5 TU), but significant variations occur, even over small distances. From these variations likely areas of recharge and storage capacity are determined. A routine sampling program is under way in these areas. A number of boreholes were chosen for sampling at regular intervals and at specific depths. Because of poor rainfall during the survey, and the limited period covered, little time variation has so far been observed. Groundwater age stratification can be demonstrated by spot sampling in some existing boreholes. (Knapp-USGS)
W71-04378

TRITIUM AND OXYGEN-18 IN NATURAL WATER SAMPLES FROM SWITZERLAND, Bern Univ. (Switzerland); and Pisa Univ. (Italy). For primary bibliographic entry see Field 02E. W71-04379

STABLE CARBON AND OXYGEN ISOTOPES OF NATURAL WATERS IN THE NETHERLANDS, Groningen Rijksuniversiteit (Netherlands).

W. G. Mook

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No Sm-129/12, p 163-190, 1970. 28 p, 15 fig. 4 tab. 21 ref.

Descriptors: *Stable isotopes, *Carbon, *Oxygen, *Water chemistry, Water balance, Groundwater, Surface waters, Sea water, Water sources, Hydrologic cycle, Evaporation, Precipitation (Atmospheric), Estuaries, Mixing, Carbonates, Water temperature.

Identifiers: *The Netherlands.

The carbon and oxygen isotopes in the Dutch surface water and groundwater present an internally consistent picture of the hydrologic cycle. The O-18 content of the average annual precipitation is -7.9 parts per thousand. The groundwater generally reflects the isotopic composition of precipitation during the seasons of maximum infiltration. River water appears to have a component derived from groundwater. The C-13 of the dissolved bicarbonate generally varies between -12 and -8 parts per thousand, largely due to isotope exchange with the atmospheric CO2. Rivers supplied by meltwater and rainwater show opposite variations in O-18 content, the Rhine from -9 to -10 parts per thousand and the Vecht from -7.5 to -6.5 parts per thousand between winter and summer respectively. In an estuary the isotopic compositions of the bicarbonate and the water turn out to be solely determined by the mixing ratio of the fresh and sea water. The O-18 chlorinity relation yields a straight line, whereas the similar relation for C-13 gives a smooth curve, the form depending on the relative quantities of dissolved carbon in the fresh and sea water. In the lake Ijsselmeer the C-13 content approaches an isotopic equilibrium with atmospheric CO2 along the flow direction, due to the relatively long residence time of the water in the lake. (Knapp-USGS) W71-04380

SOURCES OF DISSOLVED CARBONATE SPE-CIES IN GROUNDWATER AND THEIR EFFECTS ON CARBON-14 DATING,

Geological Survey, Washington, D.C F. J. Pearson, Jr., and B. B. Hanshaw

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/18, p 271-286, 1970. 16 p, 4 fig.

Descriptors: *Radioactive dating, *Groundwater, *Water chemistry, *Carbonates, Chemical reactions, Solubility, Aqueous solutions, Leaching, Ion exchange, Carbon radioisotopes, Stable isotopes. Identifiers: *Carbon-14 dating, *Carbon isotopes, *Carbon isotope ratios.

The sources of dissolved carbonate species in groundwater systems must be known in order to correct C-14 measurements to determine true or to correct relative groundwater ages. The contributions of the various sources can be estimated from C-13/C-12 ratios and from total carbonate content measurements on the water. Atmospheric precipitation generally contains no dissolved carbonate; the initial carbonate dissolved in groundwater comes from the soil atmosphere and soil carbonate minerals. Theoretical considerations and field studies in Florida, New York, and Texas show that carbonate dissolved from the soil air has values of delta C-13 of about (-) 25 parts per thousand, and the C-14 value is about the same as recent values; these are identical with those of plants. The major source of additional carbonate in deeper parts of a groundwater system is solution of carbonate minerals. In nearly pure carbonate systems, such as the principal Floridan aquifer, this solution about doubles the content of dissolved carbonate species, and delta C-13 is about 1.2% and true C-14 is about twice that measured. Where ionic interaction is affected by silicate dissolution, cation

exchange, or mixing of dissimilar waters, the dissolved carbonate content can increase further. Several no non-mineral sources may also add dissolved carbonate to groundwater. Isotope exchange theoretically could change the ratios, but field studies show no evidence that exchange occurs in the temperature range of most ground-waters. (Knapp-USGS) W71-04381

GROUNDWATER MEASUREMENTS AT THE SITE OF THE SYLVENSTEIN DAM IN THE BAVARIAN ALPS.

Gesellschaft fuer Strahlenforschung m.b.H., Mu-(West Germany). Institut Radiohydrometrie. W. Drost.

W. Diost.
In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/25, p 421-437, 1970. 17 p, 14 fig, 1 tab, 8 ref.

Descriptors: *Radioisotopes, *Stable isotopes, *Tracers, *Reservoir leakage, Grouting, Deuterium, Seepage, Oxygen, Water loss, Groundwater movement, Tracking techniques, Water temperature, Sampling, Flow, Porous media, Nuclear moisture meters, Radioactivity techniques. Identifiers: *Alps, *Bavaria, *Oxygen isotopes.

At the site of the Sylvenstein dam in the Bavarian Alps, 14 series of groundwater measurements were made between 1961 and 1969 to determine seepage rates and seepage paths through the grout curtain of the gravel-filled dam. Borehole dilution techniques, temperature measurements, and Dand O-18 measurements were carried out. Measurements were made at 50 groundwater points in front of and behind the grout curtain. Taking the average flow line density to calculate seepage rate, a mean value of 50 liters/sec was derived. This seepage rate did not vary during the observation period and is considerably lower than the original groundwater flow of 150 liters/sec. (Knapp-USGS) W71-04385

ISOTOPIC HYDROLOGICAL STUDIES OF THE NORTHWEST SAHARA (FRENCH),

Centre de Recherches sur les Zones Arides, Paris (France); and Paris Univ. (France). Faculte des Sciences.

For primary bibliographic entry see Field 02A. W71-04386

RUNOFF FROM **FORESTED** CATCHMENTS BY SUBSURFACE ROUTES, Forest Service (USDA), Columbus, Ohio. Northeastern Forest Experiment Station. For primary bibliographic entry see Field 04A. W71-04401

BROMIDE AND IODIDE IN OILFIELD BRINES IN SOME TERTIARY AND CRETACEOUS FOR-MATIONS IN MISSISSIPPI AND ALABAMA, Bureau of Mines, Bartlesville, Okla. Bartlesville

Petroleum Research Center.

A. Gene Collins, William P. Zelinski, and Cynthia

A. Pearson.

Bureau of Mines Report of Investigations 6959, June 1967. 27 p, 1 fig, 3 tab, 52 ref.

Descriptors: *Groundwater, *Oil fields, *Chemical analysis, *Halogens, *Chemical reactions, Geochemistry, Brines, Mississippi, Alabama, Geology, Water, Oil, Petrology, Chlorides, Sedi-mentary petrology, Rocks, Geologic formations, Sampling, Data collections, Sediments, Tertiary

Identifiers: *Oilfield brines, (Ala. and Miss.), Bromide. Iodide. Cretaceous formation.

The Bureau of Mines investigated the bromide and iodide content of Mississippi and Alabama oilfield

Field 02—WATER CYCLE

Group 2F—Groundwater

waters of the Tertiary and Cretaceous period to determine genetic relationships of the ions, to determine their origin, and to determine their genetic relation to petroleum. The 280 samples were analyzed after a pretreatment to remove interferences. The iodide was oxidized to iodate and was titrated with thiosulfate. The bromide was oxidized to bromate and was determined iodometrically. A computer was used to calculate the correlation coefficients of iodide to bromide and to other ions. The other ions are sodium plus potassium, calcium, magnesium, chloride, bicarbonate, and sulfate. The mineral content of the samples ranged from 52 to 1,760 mg/liter for bromide and from 2 to 65 mg/liter for iodide. The mean bromide-to-chloride and iodide-to-chloride ratios were 0.0065 and 0.0002. The correlation coefficient matrix and linear plots indicated a definite bromide-to-calcium relationship for the brines investigated. (Woodard-USGS) W71-04417

MANAGEMENT AND ADMINISTRATION OF GROUNDWATER IN INTERSTATE AND INTERNATIONAL AQUIFERS, PHASE I,

Bittinger (M. W.) and Associates, Inc., Fort Collins, Colo. For primary bibliographic entry see Field 04B.

W71-04541

NUMERICAL SIMULATION OF DISPERSION IN GROUNDWATER AQUIFERS,

Colorado State Univ., Fort Collins. Dept. of Agricultural Engineering; and Colorado State Univ., Fort Collins. Dept. of Civil Engineering. For primary bibliographic entry see Field 06A. W71-04559

SALT WATER INTERFACE DURING GROUND-

WATER PUMPING, Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Science and Engineering. For primary bibliographic entry see Field 04B.

W71-04571

COMMON STRATIGRAPHIC BOUNDARIES WITH COASTAL ASSOCIATED PLAIN AQUIFERS,

Maryland Geological Survey, Baltimore.

Harry J. Hansen. Groundwater, Vol 9, No 1, p 5-12, January-February 1971. 8 p, 10 fig, 21 ref.

Descriptors: *Model studies, *Groundwater movement, *Aquifers, *Stratigraphy, *Boundaries (Surfaces), Coastal plains, Maryland, Analog models, Mathematical models, Hydraulic models, Hydraulic similitude, Water levels, Water wells, Water

Identifiers: Aquifer models, Aquifer simulation.

There is a tendency during the verification stage of aquifer model building to manipulate stratigraphic boundaries. This procedure is acceptable insofar as the geohydrologist is sufficiently knowledgeable to sense the point at which the manipulations encroach upon the integrity of his model. Examples from the Maryland Coastal Plain are used to depict several types of stratigraphic boundaries. These include erosional truncation, overlap (or pinchout), disconformity, and facies change. Defining statements are given for each in order to clarify the stratigraphic implications of boundary modeling. (Knapp-USGS) W71-04577

USE OF GROUNDWATER IN DEVELOPING THE MEKONG DELTA, REPUBLIC OF VIET NAM.

Earth Science Research Corp., Santa Monica, Calif.

For primary bibliographic entry see Field 04B. W71-04579

TYPE-CURVE SOLUTION OF STEP-DRAW-DOWN TEST,

Layne Northern Co., Inc., Lansing, Mich.

N. Thomas Sheahan. Groundwater, Vol 9, No 1, p 25-29, January-February 1971. 5 p, 2 fig, 2 ref.

Descriptors: *Aquifers, *Drawdown, *Water level fluctuations, Laminar flow, Groundwater movement, Theis equation, Thiems equation, Water table, Water wells, Withdrawal, Hydraulics, Transmissivity, Storage coefficient.

Identifiers: *Drawdown type-curves, *Aquifer testing, *Pumping tests, *Rorabaugh equation.

A set of type-curves is presented which simplifies and quickens the solution of the Rorabaugh equation for drawdown in a pumping well by eliminating the trial-and-error computations. Type-curve analysis of test data in the field, before pumping is discontinued, provides an indication of the accuracy, test data should cover the portion of maximum curvature of the curve, and the range between the lowest and the highest pumping rates used in the step-drawdown test should be great enough to define a unique curve. (Knapp-USGS) W71-04580

RECHARGE CHARACTERISTICS OF WATERCOURSE AQUIFER SYSTEM AT SPRINGFIELD, OHIO, Geological Survey, Columbus, Ohio; and Ohio Dept. of Natural Resources, Columbus. Div. of

Water.

For primary bibliographic entry see Field 04B. W71-04581

HYDROGEOPHYSICAL SURVEY USING REMOTE-SENSING METHODS **FROM** KAWAIHAE TO KAILUA-KONA, HAWAII, Hawaii Univ., Honolulu. Dept. of Geology; and Michigan Univ., Ann Arbor. For primary bibliographic entry see Field 07B. W71-04582

VERTICAL ZONING IN CHEMICAL COMPOSI-TION OF GROUNDWATER IN MASSIFS OF EASTERN MONGOLIA AND SOUTHEASTERN

TRANSBAIKAL, Akademiya Nauk SSSR, Moscow. Research Lab. of Foreign Geology. For primary bibliographic entry see Field 02K.

TRACER DISPERSION IN GROUNDWATER

EXPERIMENTS. Institute of Nuclear Physics, Krakow (Poland). A. Lenda, and A. Zuber.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/37, p 619-641, 1970. 23 p, 7 fig, 3 tab, 31 ref.

Descriptors: *Tracers, *Dispersion, *Groundwater movement, On-site tests, Pumping, Water wells, Aquifers, Radioactivity techniques, Tracking techniques, Diffusion, Mixing, Flow, Porous media, Mathematical studies, Statistical methods. Identifiers: *Groundwater dispersion, *Aquifer tests, *Aquifer evaluation, *Pumping tests.

Theoretical problems of the two-well and multiwell tracer techniques generally used for measurements of natural groundwater velocities are discussed. Analytical solutions are given for dif-ferent measurement geometries. For a point injection and a line injection in an infinite medium. theoretical breakthrough curves are given graphically in a normalized form. They allow estimation of the amount of tracer or carrier needed. They can also be used to find the appropriate transit time and dispersion coefficient from the measured breakthrough curves. Approximate analytical solutions for radial flow are also given graphically. All

the formulas are valid for any value of the dimensionless dispersion parameter. Comparison of the theoretical solutions with several experiments shows their applicability. For planning a field experiment the dispersion parameter has to be known; therefore, existing theoretical, laboratory and field data on dispersion coefficients were compiled and are given in a comprehensive form. (Kw71-04598

APPLICATION OF THE SINGLE-WELL TECHNIQUE THROUGH THE LABELLING OF THE WHOLE PIEZOMETRIC COLUMN (SPANISH),
Ministry of Public Works, Madrid (Spain). Dept. of

Nuclear Applications.

E. Baonza, A. Plata, and E. Piles.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/42, p 695-711, 1970. 17 p, 6 fig,

Descriptors: *Tracers, *Radioactive well logging, *Groundwater movement, Hydrogeology, Aquifers, On-site tests, Tracking techniques, Borehole geophysics, Tagging, Sampling. Identifiers: *Aquifer testing.

A tracer method for aquifer testing is based on the simultaneous labelling of the whole column of water in the borehole and the immediate study of its behavior. The probes used were enclosed in a series of tubes in which perforations cover a known percentage of their lateral surface. If no vertical flow exists, the horizontal velocity can be measured. The presence of turbulent vertical flow results in the progressive disappearance of the tracer from the area in which the flow originates towards the area of horizontal displacement. In the case of aquifers in limestone or other hard formations, this technique makes it possible to pinpoint the fissures through which the water circulates. The principal advantages of this method are: (a) rapidity in obtaining results; (b) simultaneous supply of information over all the piezometric column; and (c) simplicity. This technique, used repeatedly in studies of underground water carried out at various points in Spain, including the Costa del Sol, yields qualitative and quantitative information about characteristics of the aquifers. Its use prior to other more complete but slower and more costly methods can give results which make it possible to orientate subsequent work in the most useful direction. (Knapp-USGS) W71-04602

HYDROGEOLOGY OF AREA SOUTHWEST OF DUVANJSKO POLJE.

Institute for Geological and Geophysical Research, Belgrade (Yugoslavia). J. Vilimonovic.

Trans. From Vesnik Zovoda Za Geoloska i Geofizicka Istrazivanja, Ser B, No 8, p 131-139, 1968. Available from NTIS as TT 68-50062. Bulletin of Engineering Geology and Hydrogeology, Ser B, No 8, p 117-124, 1968. 8 p, 4 fig, 5 ref, 2

Descriptors: *Hydrogeology, *Karst, Hydrology, Geology, Geomorphology, Topography, Stratigraphy, Groundwater movement, Aquifers, raphy, Groundwater move Aquicludes, Structural geology. Identifiers: *Yugoslavia.

The hydrogeology of a karstic region of the outer Dinarides in Yugoslavia, which includes the groundwater divide of the drainage basins of the rivers Cetina and Neretva and the direct drainage basin of the Adriatic Sea, is described with particular reference to the relationships between permeable and impermeable rocks. The lithology and the tectonics of the area, hydrogeological and geomorphological phenomena associated with the flow of groundwater, and the hydrogeology and the directions of flow of groundwater are reviewed. (Knapp-USGS) W71-04609

A METHOD OF STUDYING THE HYDRODYNAMIC REGIME OF KARST AQUIFERS BY ANALYSIS OF THE DISCHARGE CURVE AND LEVEL FLUCTUATIONS DURING RECESSION,

Institute for Geological and Geophysical Research,

Belgrade (Yugoslavia). B. Mijatovic.

Trans. from Vesnik Zavoda Za Geoloska i Geofizicka Istrazivanja, Ser B, No 8, p 43-81, 1968. Available from NTIS as TT-68-50062. Bulletin of Engineering Geology and Hydrogeology, Ser B, No 8, p 41-74, 1968. 34 p, 14 fig, 9 tab, 11 ref

Descriptors: *Karst, *Hydrogeology, *Recession curves, *Hydrograph analysis, Water yield, Transmissivity, Storage coefficient, Water levels, Hydrodynamics, Groundwater movement, Water level fluctuations

Identifiers: *Karst hydrogeology, Yugoslavia.

The hydrodynamics of karst aquifers may be studied by analysis of the recession curves of the hydrograms of springs and watercourses and by means of water level fluctuations. Its great advantage is the simple determination of hydrogeological parameters: exhaustion coefficient, storage coefficient, transmissibility, and coefficient of effective infiltration, which are essential for various calculations of the water balance and reserves. The fundamental hydraulic parameter on which all the calculations are based is the exhaustion coefficient, which qualitatively expresses the relationship between aquifer geometry and hydrology. The functional relationship between a and the transmissibility and the storage coefficient is found by analysis of the recession equation. The accuracy of the results depends exclusively on the hydrometric observation data. (Knapp-USGS) W71-04611

HYDROGEOLOGICAL POSSIBILITIES FOR MORE EFFICIENT INTERCEPTION OF GROUNDWATER IN KARST,

Institute for Geological and Geophysical Research, Belgrade (Yugoslavia). For primary bibliographic entry see Field 03B. W71-04612

2G. Water in Soils

AVAILABLE MOISTURE STORAGE CAPACI-TIES OF SOME LIMESTONE DERIVED SOILS, Missouri Univ., Columbia.

David Andrew Ruppert.

M Sc Thesis, Missouri University Graduate School, January 1970. 110 p, 33 fig, 11 tab, 38 ref, 3 append. OWRR Project B-022-MO (1).

Descriptors: *Soil moisture, *Soil structure, *Soilwater-plant relationships, *Limestones, *Soil water movement, Soil types, Storage capacity, Clays, Soil properties, Porosity, Soil tests, Soil surfaces, Vegetation effects, Infiltration, Earth-water interfaces, Soil compaction.

Identifiers: *Limestone-derived soils.

The moisture storage capacities of limestone derived soils were studied in relation to the depths to carbonate rock. The major site picked for this study was an area in Missouri where depth to carbonate rock decreased with distance, and where, at a critical depth to bedrock, a natural boundary between forest and prairie vegetation existed. The soils were characterized in order to establish their similarity to limestone derived soils previously studied. The available moisture storage capacities of these soils were determined in order to observe the changes in available moisture storage capacity associated with varying depths to carbonate rock.

The consumptive demand for moisture was estimated at the soil sites in order to test the hypothesis that periods of drought existed in the shallower soils while the deeper soils were able to supply moisture throughout the growing season. A vegetative survey was made in order to relate the vegetative pattern to the depths to bedrock, the available moisture storage capacities, and the consumptive moisture demand. As the depth to carbonate rock varies from 10-50 inches the maximum bulk density of the soil profile increases from 0.8 to 1.5 g/cc. Woodward-USGS) W71-04365

STUDY OF A DOLOMITIC AQUIFER WITH CARBON-14 AND TRITIUM,

Department of Water Affairs, Pretoria (South Africa); and Council for Scientific and Industrial Research, Pretoria (South Africa). National Physical Research Lab

D. B. Bredenkamp, and J. C. Vogel.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No Sm-129/21, p 349-372, 1970. 24 p, 8 fig, 5 tab, 11 ref.

Descriptors: *Carbon radioisotopes, *Tritium, *Tracers, *Radioactive dating, *Groundwater movement, Hydrogeology, Water storage, movement, Hydrogeology, Water storage, Recharge, Discharge (Water), Springs, Aquifers, Water balance, Transmissivity, Carbonates, Carbonate rocks, Dolomite. Identifiers: *Transvaal (S. Africa).

The Dolomite Series which outcrops over an extensive area of the Transvaal is frequently subdivided into separate groundwater compartments by vertical diabase dykes to form well-defined aquifers which usually overflow in strong springs at the lowest point on the surface. The hydrology of one such compartment was analyzed to provide figures for the aquifer characteristics which can be com-pared with the results of isotope data. The recharge rate of the aquifer is 17.7 mm/yr and the storage capacity is about 57 times the annual recharge. The initial C-14 content of the groundwater varies from 80 to 90% with the result that this isotope is relatively unsuitable for quantitative deductions. Both C-14 and tritium show a linear increase in age with depth in accordance with the theory. From the triti-um results a recharge rate of 11.5 mm/yr, and a storage capacity of 106 times the annual recharge are deduced. Practically the same results are obtained from the tritium content of the spring water if the initial tritium content of the recharge, extrapolated from the age-depth curve (7 TU), is used and the relationship between average age and apparent age of the discharge employed. (Knapp-USGS) W71-04371

CARBON-14 CONCENTRATION OF LIME IN SOILS AND ASPECTS OF THE CARBON-14 DATING OF GROUNDWATER,

Landesamt Niedersaechsisches Bodenforschung, Hanover (West Germany).

M. A. Gehv.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/14, p 215-223, 1970. 9 p, 1 fig, 2 tab, 15 ref.

Descriptors: *Carbon radioisotopes, *Groundwater, *Radioactive dating, *Soil water, Soil water movement, Soil chemistry, Water chemistry, Infiltration, Water circulation, Recharge, Carbonates, Leaching, Carbon dioxide, Mixing. Identifiers: *Groundwater dating, *Radiocarbon dating (Groundwater).

Carbon-14 age determinations of groundwater are based on the assumption that the soil lime which is dissolved during the passing of CO2-containing

rain water is free of radiocarbon. In contrast to this the results of the C-14 determinations from recent groundwaters do not agree with the theoretical values of the dilution factor determined from the content of free and fixed carbonate species of the groundwater. In all cases the mean C-14 concentration of the groundwater was higher than expected in theory even if corrections of an improved water dating model have been used. Measurements of the C-14 concentration of more than ten different soils show that the basic assumption is not correct. The carbonate in the uppermost layer of the soil have a C-14 content between 2 and 70% modern, normally lying within a range of 2 to 15% modern. It is supposed that this radiocarbon is accumulated during the summer with its low recharge rate by precipitation of lime when the water in the uppermost layer is evaporated. During the time of highest groundwater recharge this lime will be dissolved by the leak water and transported to the aquifer. On the supposition that such or a similar process corresponds to the common mechanism in nature, the calculations show that the previously measured C-14 concentrations of recent groundwaters are in accordance with the theoretical values. (Knapp-W71-04376

ROUTINE ESTIMATION OF SOIL MOISTURE DEFICITS,
British Meteorological Office, Bracknell (En-

gland).

J. Grindley, and F. Singleton.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 811-820, 1969. 10 p, 4 fig, 7 tab, 6 ref.

Descriptors: *Soil moisture, *Moisture content, *Water supply, *Flood forecasting, *Evapotrans-piration, Water balance, Infiltration, Antecedent precipitation, Effective precipitation, Storm runoff, Streamflow forecasting, Mapping. Identifiers: Soil moisture deficit, United Kingdom.

Since the autumn of 1962 the United Kingdom Meteorological Office has issued maps of estimated soil moisture deficit to authorities concerned with flood warning and water supply. The method of estimation is to assume a zero deficit during the late winter and thereafter to calculate the cumulative effect of rainfall minus evaporation. Assessment of evaporation is made using a shortened version of Penman's formula. Allowance is made for the inhibition of evaporation from vegetation when soil moisture deficits are large, and the variation of this effect with root length. When considered important, maps of effective precipitation are also issued. Effective precipitation during a period is defined as the excess precipitation over and above that needed to make good the soil moisture deficit which existed at the beginning of the period, with allowance being made for evaporation. Examples of both types of map are shown and their use to river authorities is discussed. (Knapp-USGS) W71-04396

DETERMINATION OF STORM RUNOFF BY THE USE OF INFILTRATION INDEX, Ministry of Railways, Lucknow (India) For primary bibliographic entry see Field 02A. W71-04397

STORM RUNOFF FROM CATCHMENTS BY SUBSURFACE ROUTES, Forest Service (USDA), Columbus, Ohio. Northeastern Forest Experiment Station. For primary bibliographic entry see Field 04A. W71-04401

USE OF GAMMA EMISSION FROM AMERICUM-241 TO MEASURE THE WATER CONTENT OF NONSATURATED SOIL SAMPLES (FRENCH),

Univ. (France). Laboratoires de Grenoble Mecanique des Fluides.

Field 02—WATER CYCLE

Group 2G—Water in Soils

G. Vachund, J. Cisler, J. L. Thony, and L. de Backer.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/39, p 643-661, 1970. 19 p, 8 fig, 2 tab, 16 ref.

Descriptors: *Nuclear moisture meters, *Soil moisture meters, *Gamma rays, Calibrations, Instrumentation, Soil moisture, Soil water, Moisture meters, Nuclear meters, Radioactivity techniques. Identifiers: *Nuclear soil moisture meters.

Because americium-241 has a narrow, well-defined main peak corresponding to the emission of a 60keV gamma ray, it is very useful for soil water measurements by the gamma-attenuation method, the main advantage being the thinness of the shield needed to protect the source. The gamma radiation emitted by a 0.1-Ci source is collimated into a beam 4 mm in diameter. The source-detector assembly can be moved so as to permit surveying of the sample in a vertical plane. By making a depression at the base of the sample it can be saturated or desaturated, and the changes in water content between the two states of equilibrium can be followed by the gamma-attenuation method. For the measurement geometry used in the tests described, the mass attenuation coefficient of the water is only 0.1788 g/sq cm, its theoretical value being 0.204. Improved collimation gives 0.1998 g/ sq cm. The results obtained with moderate collimation can be very accurate, provided that the corresponding value of the attenuation coefficients is carefully determined. (Knapp-USGS) W71-04599

WATER-FLOW CALCULATIONS BY MEANS OF GAMMA-ABSORPTION AND TENSIOMETER FIELD MEASUREMENTS IN THE UNSATURATED SOIL PROFILE,

Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (West Germany); and Bundesanstalt fuer Bodenforschung, Hanover (West Germany).

W. Giesel, S. Lorch, M. Renger, and O. Strebel. In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/40, p 663-672, 1970. 10 p, 4 fig,

Descriptors: *Soil water movement, *Soil moisture *Tensiometers, meters, *Water Evapotranspiration, Instrumentation. moisture, Nuclear moisture meters, Hydraulic conductivity, On-site tests, Consumptive use.

Identifiers: *Soil water flowmeters, *Soil densitometers.

By means of a double-probe densitometer and a tensiometer, variations in the soil water content and soil moisture suctions may be determined as a function of time in different horizons of a soil profile. From these data are computed the water flow, evapotranspiration, and exchange of moisture between the soil and groundwater zones. By including the precipitation, the essential components of the water balance equation are measured. In addition, it is possible to obtain from the field measurements the relations between soil water suction and hydraulic conductivity for the individual horizons of a profile. (Knapp-USGS) W71-04600

PENETRATION RADIOACTIVE LOGGING FOR THE STUDY OF NON-SATURATED AND SATURATED AREAS (RUSSIAN),

All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR). or primary bibliographic entry see Field 04B. W71-04601

RADIOMETRIC METHOD FOR INVESTIGAT-ING THE PERMEABILITY OF RESERVOIR BEDS (RUSSIAN),

Polish Academy of Sciences, Gdansk. Inst. of Hydraulic Research.

For primary bibliographic entry see Field 04A. W71-04603

NEUTRON INVESTIGATION OF THE RATE OF WATER SEEPAGE FROM IRRIGATION CHAN-NELS AND RESERVOIRS IN LOESSIAL

LOAMS (RUSSIAN), All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR). For primary bibliographic entry see Field 04A. W71-04604

2H. Lakes

EFFECTS OF A CAUSEWAY ON THE CHEMIS-TRY OF THE BRINE IN GREAT SALT LAKE,

Geological Survey, Salt Lake City, Utah. For primary bibliographic entry see Field 04C. W71-04369

DEUTERIUM AND OXYGEN-18 IN WATER OF

LAKE CHAD (FRENCH),
Paris Univ. (France). Faculte des Sciences;
Comitato Nazionale per le Ricerche Nucleari, Pisa
(Italy). Laboratorio di Geologia Nucleare; and Office de la Recherche Scientifique et Technique

Outre-Mer, Fort-Lamy (Chad).

J. Ch. Fontes, R. Gonfiantini, and M. A. Roche. In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/23, p 387-404, 1970. 18 p, 11 fig, 3 tab, 20 ref.

*Deuterium, *Oxygen, Descriptors: isotopes, *Lakes, *Water balance, Evaporation, In-Streamflow, Precipitation (Atmospheric), Hydrogeology, Sampling, Arid lands, Climates, Water chemistry, Water temperature. Identifiers: *Lake Chad, *Oxygen isotopes.

Lake Chad is a water body, without outlet, of approximately 20,000 sq km in the heart of tropical Africa. In this semi-arid zone with a climate ranging from the western-Sahara to the sub-desert type, the high rate of evaporation (over 2 m per year) gives rise to an extensive isotopic tracing effect in the surface waters. The proportions and nature of the hydrogeological problems of this internal drainage basin of more than 2 million sq km provide justification for the use of isotope techniques. Four pluviometric stations situated at the north and south of the lake provide a means for evaluating the weighted mean isotopic composition of rainfall on the lake. Weekly sampling and gaging carried out on the Chari River (accounting for 94% of the inflow from rivers) indicates an annual isotopic modulus of -3.3 parts per thousand O-18 vs SMOW in 1967 and 2.8 parts per thousand in 1969. The heavy isotope content increases with distance from the mouth of the Chari. The increase amounts to 20 parts per thousand in oxygen-18 and 110 parts per thousand in deuterium in the isolated branches of the northeast shore. However, the enrichment varies with time, as a function of the inflow conditions and the various climatic parameters, and affords a means of defining two areas of evolution in the lake. The influence of the evaporation enriched waters of the lake is very distinct in the fringe of groundwater near the shore but further inland it disappears. (Knapp-USGS)

PEOPLE EX REL CARLSTROM V HATCH (OWNERSHIP OF MARSH MEANDERED AS A LAKE).

350 III 586, 183 NE 610-613 (1932).

Descriptors: *Illinois, *Land tenure, *Prescriptive rights, *Meanders, Real property, Navigable waters, Lakes, Marshes, United States, State governments, Judicial decisions, Legal aspects, Land, Local governments, Governments.

Plaintiff state brought action against defendant in possession to quiet title to marshland. The land in question had been surveyed and meandered as a navigable lake. However, no lake existed, and the land was a marsh. Congress had conveyed all marshland to the state, which had reconveyed it to the respective counties. Defendant claimed the land by adverse possession against the county. Plaintiff contended that: (1) the United States, by establishing the meander, had ceded title to the state in trust for the people, and (2) unlike suits against a county, a suit in adverse possession could not be maintained against the state. Observing that the surveyor had no authority to fix a meander where no navigable lake existed, the Supreme Court of Illinois held that title had passed under the conveyance of marsh lands to the state. Since defendant had established title by adverse possession, title was held in defendant. (Hart-Florida) W71-04438

A GEOLOGIC STUDY OF THE CHEMICAL QUALITY OF MEDICINE LAKE, South Dakota Univ., Vermillon. Merlin J. Tipton, and Richard G. Stockdale. Available from NTIS as PB-197 529, \$3.00 in paper copy, \$0.95 in microfiche. Completion Report, South Dakota Water Resources Research Institute Language 1071, \$1, 2, 2, 2, 5, 7, 6, 16, and for the control of the contr stitute, January, 1971. 51 p, 2 tab, 7 fig, 16 ref, 4 append. OWRR Project A-022-SDAK (1) and B-022-SDAK (1).

Descriptors: Hydrologic aspects, Water quality, *Evaporation, Chemical analysis, *Lakes, Sediments, South Dakota, *Dissolved solids, Drainage patterns (Geologic), *Drainage systems, Geomorphology, Saline lakes.

Identifiers: *Medicine Lake (So Dak), *Closed drainage, Sediment cores.

Medicine Lake is a saline lake lying on the western flank of the Coteau des Prairie in Codington Counflank of the Colean des France in Coolington Cole.

19, SD. Total dissolved solids content ranges from 35,000 parts per million. The source of the salts entering Medicine Lake is the result of 'normal' weathering of geologic materials. The weathering products go into solu-tion with the groundwater, which is the primary source of recharge for Medicine Lake. Vertical control data, supported by remote sensing thermal imagery, established Medicine Lake to be a closed drainage. Because evaporation exceeds precipitation large quantities of water are lost from the closed drainage system. Groundwater movement is toward Medicine Lake from the southeast through McKillicans Lake, Round Lake, and Horseshoe Lake Groundwater movement toward Medicine Lake from the northwest is through a series of potholes. During the time groundwater is moving toward Medicine Lake it is exposed to evaporation whenever it occupies one of the other lake basins. As a consequence of this, concentration of the initial groundwater starts in McKillicans Lake and progresses, with more evaporation and concentration occurring, each time it is exposed in a lake basin. Medicine Lake, lying at the lowest elevation in the closed drainage system, receives ground-water that has already been concentrated during its migration through the chain of lakes and potholes. Medicine Lake, because it is recharged by concentrated groundwater, should, through more evapora-tion, contain the highest total dissolved solids content which it does. The combination of a closed drainage system and a high rate of evaporation seems to be the best explanation for the chemical quality of the water in Medicien Lake. W71-04517

APPLICATION OF THE THEORY OF GRAPHS IN INVESTIGATION OF COMMUNITIES OF AQUATIC ORGANISMS, (IN RUSSIAN), Akademiya Nauk SSSR, Leningrad. Institut Evolyutsionnoi Fiziologii i Biokhimii.

For primary bibliographic entry see Field 07B.

CONTRIBUTION TO THE EPIPHYTIC ALGAL FLORA OF THE LAKE NEUSIEDLER, (IN GER-MAN),

Vienna Univ. (Austria). Botanisches Institut und Botanischer Garten.

Lothar Geitler.

Osterreichische Botanische Zeitschrift, Vol 118, No 1/2, p 17-29, 1970. 3 fig, 24 ref.

Descriptors: *Epiphytology, *Lakes, *Algae, Alkaline water, Magnesium, Sodium sulfates, Cyanophyta, Rhodophyta.

Identifiers: *Lake Neusiedler (Austria), Chamaesiphon subaequalis, Apistonema expansum, Porphyridium griseum, Chrysotrichalae.

Detailed descriptions are given of the following new species of algae revealed in the alkaline Lake Neusiedler: Chamaesiphon subaequalis Apistonema Cyanophyceae, expansum Chrysotrichalae, and Porphyridum griseum of Rhodophycea. The paper included a record of some previously identified algae of the lake. (Wilde-Wisconsin) W71-04526

THE ROLE OF ZOOPLANKTON IN THE OR-GANIC MATTER DECOMPOSITION IN AN EUTROPHIC LAKE, (IN RUSSIAN), Akademiya Nauk SSSR, Moscow. Institut Evolyut-

sionnoi Morfologii.

A. P. Shcherbakov, and A. I. Ivanova. Zhurnal Obshchei Biologii, Vol 30, No 2, p 140-145, 1969. 4 tab, 16 ref.

Descriptors: *Lakes, *Zooplankton, *Decomposing organic matter, *Oxygen, Eutrophication, Hydrogen sulfide, Copepods, Crustaceans, Daphnia, Rotifers, Protozoa, Predation.

Identifiers: *Moscow region, Beloye Ozero (USSR), Gloobokoye Ozero (USSR), Vinberg coefficients.

The object of this study, the eutrophic Lake Beloye, exhibits one peculiarity: its hypolimnion during the stagnation period attains a critically high concentration of hydrogen sulfide precluding the survival of zooplankters; consequently, the esti-mates of oxygen consumption by zooplankton in ice-free water were confined to the epilimnion. The average diurnal consumption during the five warm months was 0.37 mg/l, constituting 17% of the total consumption of oxygen by biota of the lake. The results were comparable with those obtained previously in investigations of the Lake Gloobokoye, located in the same climatic region. In both water basins, the predatory fraction of zooplankters consumed about 25% of oxygen. (Wilde-Wisconsin) W71-04531

LIMNOLOGICAL STUDIES ON THE OREGON COAST. 1. WOAHINK LAKE,

Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.

Douglas W. Larson.

Water Resources Research Institute, Oregon State University, Corvallis, WRRI-3, 1970. 40 p, 10 fig, 9 tab, 30 ref. OWRR Project A-003-ORE (2).

Descriptors: *Lakes, *Limnology, Hydrologic aspects, Chemical properties, Crustaceans, Nutrients, Salmon, Bioassay, Water analysis, Phytoplankton, Zooplankton, Primary productivi-

Identifiers: *Woahink Lake (Ore), Crater Lake (Ore), "Odell Lake (Ore), Waldo Lake (Ore), Ekman dredge sampler.

The limnology is documented of the recreationally outstanding Woahink Lake (Oregon). Investigated characteristics of water included temperature, dissolved oxygen, pH, specific conductance, transmission of incident radiation, dissolved solids, alkalinity, hardness, and contents of sodium, potassium, calcium, magnesium and zinc. The record of organisms includes representative genera of phytoplankton and the annual distribution of most important adult and juvenile members of zooplankton. Chlorophyll a, carbon dioxide, and primary productivity constituted other analyses. The results are compared with those obtained for three other Oregon lakes. The study was supplemented by a bioassay employing phosphorus, iron, nitrates, ammonia, and labeled sodium carbonate. (Wilde-Wisconsin) W71-04536

BIOLOGICAL FIXATION AND TRANSFORMA-TION OF NITROGEN IN SMALL IMPOUND-MENTS,

Oklahoma State Univ., Stillwater. Dept. of Zoolo-

Dale W. Toetz.

Available from NTIS as PB-197 586, \$3.00 in paper copy, \$0.95 in microfiche. Oklahoma Water Resources Research Institute, Completion Report, July 1970. 34 p, 3 tab, 4 fig, 21 ref. OWRR Project No A-012-OKLA (1).

Descriptors: *Nitrogen fixation, Ammonia, Impoundments, *Ammonification, Nitrates, *Nitrification, Diel, Oklahoma, *Analytical techniques. Lakes, Ponds, Cyanophyta.

Identifiers: Acetylene reduction method, 15N technique, *Ceratophyllum, Nitrate assimilation, Ammonia nitrate, Ammonia assimilation, Diel assimilation.

Biological fixation and transformation of nitrogen was studied in impoundments in central Oklahoma using the acetylene reduction method and 15 N techniques. Nitrogenase activity, probably microbial, was detected in a small lake during the winter. This source was calculated to be only 1% of the quantity of N falling directly on the surface in precipitation. Nitrogen fixation was not detected in a highly eutrophic pond, nor was it detected in a large mainstream reservoir. In both heterocystis blue-green algae and nutrient depletion were never observed. Biological N fixation does not appear to be important in these waters. Transformation of nitrogen was studied in the small lake where nitrogen fixation was detected. A Ceratophyllumperiphyton community is large in biomass and dominates the flora. This community was found to be capable of continuous NH4 assimilation, but could assimilate NO3 most rapidly only in the light. An effort was made to learn if NH4 and NO3 assimilation by this community could be predicted from a knowledge of concentration. Uptake was linear with concentration but the effect of N starvation of the slope of the curve has not been explored. W71-04544

LAKE HOURLY DISPERSION ESTIMATES FROM A RECORDING CURRENT METER, Ontario Water Resources Commission, Toronto.

Ontario Water Resources Commission, Toronto.

Merv D. Palmer, and J. Bryan Izatt.
Journal of Geophysical Research, Vol 76, No 3, p
688-693, January 20, 1971. 6 p, 3 fig, 4 tab, 18 ref.

ONR Contract N00014-67-A-0103-0007, NR 307-

Descriptors: *Dispersion, *Water circulation, *Great Lakes, *Lake Erie, Currents (Water), Lakes, Mixing, Current meters, Path of pollutants, Tracking techniques, Correlation analysis, Probability, Markov processes, Stochastic processes, Reynolds number, Data collections, Statistical methods, Computer programs. Identifiers: *Dispersion (Lakes).

For the Great Lakes, mean hourly dispersion coefficients are predicted by using a first-order Markov chain model developed from continuous hourly current meter records at a fixed point. Dispersion coefficients compare favorably with other studies. The Eulerian data are assumed equivalent to Lagrangian because the Reynolds numbers were large, and because the velocity field was

homogeneous over the distances considered. A conventional dye injection study at Port Maitland on Lake Erie verified the conversion of data from Eulerian to Lagrangian form. Concentrations were computed as a function of distance for a constant continuous point source of a passive contaminant. A method was developed for determining the maximum, mean, and minimum probable distances traveled by a particle in a period of hours. (Knapp-USGS) W71-04565

TRITIUM STUDY OF THE MIXING OF WATERS IN LAKES AND ESTUARIES, WITH PARTICULAR REFERENCE TO THE LAKE OF GENEVA AND THE GIRONDE (FRENCH),

Paris Univ., Thonon-les-Bains (France). Center for Geodynamic Research.

M. Meybeck, P. Hubert, J. M. Martin, and Ph. Olive

Onve. In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/32, p 523-541, 1970. 19 p, 9 fig, 4 tab, 13 ref.

Descriptors: *Tracers, *Tritium, *Mixing, *Lales, *Estuaries, Density stratification, Turbidity currents, Density currents, Water circulation, Water balance, Water sources, Diffusion, Dispersion, Stratified flow, Currents (Water). Identifiers: *Lake Geneva, *Gironde.

Tritium was used as a tracer in a general study of the dynamics of the Lake of Geneva (Leman) and the Gironde in order to differentiate waters with identical physico-chemical characteristics. On the Lake of Geneva, tracers revealed a surface current. a main current at half depth and a turbidity current in a sublacustrine canyon. Three layers with their own well defined dynamic behavior (0-50 m, 50-150 m and 150-310 m) correspond to these movements. Only the surface layer may become homogeneous in winter. In the Gironde the use of tritium showed, in waters having identical or constant salinities, whether the fresh waters were of different fluvial origins. In this way a substantial difference in dynamic behavior and the absence of any significant exchanges between the edges and the center of the Gironde were found. In estuaries this method should permit the study of flood propagation and the formation of high-turbidity zones. (Knapp-USGS) W71-04594

VERTICAL DENSITY CURRENTS--II,

Geological Survey, Washington, D.C. W. H. Bradley. Limnology and Oceanography, Vol 14, No 1, p 1-3, January 1969. 3 p, 2 fig, 3 ref.

Descriptors: *Density currents, *Laminar flow, *Dispersion, *Analytical techniques, Water properties, Air circulation, Density, Particle size, Technology, Application methods, Methodology, Hydrodynamics.
Identifiers: *Vertical flow, Virology, Mycology.

Examples of vertical density currents within the laminar flow domain, one in a water solution and the other in air, are presented. The examples illustrate new ways of introducing and dispersing microscopic particles into static fluids and demonstrate that a stable, clearly defined layer of dispersed particles forms first and that the vertical density currents originate and flow from the lower part of this layer. The new information comes from wholly unrelated lines of research, one in virology, and the other in mycology, but the information provides good experimental support in hydrodynamics. A mathematical approach can be used to develop the theory of vertical density currents so that the described observations can be applied to a broader spectrum of flow phenomena in air, water, and molten rock in the earth. (Lang-USGS) W71-04606

Group 2H—Lakes

MEASUREMENT AND ANALYSIS OF THE ANNUAL HEAT BUDGET FOR THE SEDIMENTS IN TWO WISCONSIN LAKES,

Dartmouth Coll., Hanover, N. H. Dept. of Biological Sciences, and Dartmouth Coll., Hanover, N. H. Dept. of Earth Sciences.

Gene E. Likens, and Noye M. Johnson.

Limnology and Oceanography, Vol 14, No 1, p 115-135, January 1969, 21 p, 13 fig, 5 tab, 25 ref. NSF Grant No GE-366.

Descriptors: *Heat budget, *Heat flow, *Lakes, *Bottom sediments, Bogs, Wisconsin, Thermocline, Marshes, Water temperature, Measurement, Instrumentation, Methodology.

Identifiers: *Stewart's Dark Lake (Wis.), Tub Lake

(Wis.), Sediment temperatures.

Temperature was measured in the water, bottom sediments, and bog surrounding Stewart's Dark Lake and Tub Lake, Wisconsin, using a thermal probe to penetrate 8 m into the bottom material. In the deepest water of Stewart's Dark Lake, a steady state thermal gradient (0.20 deg C/m) was observed in the bottom sediments. Thermal conductivity of these gelatinous sediments was measured, a steady-state heat flow value was derived. Isotherm patterns within these sediments and the bog demonstrate the importance of solar radiation and the effects of absorption and circulation in these lakes. Seasonal isotherm pattern changes are similar for both lakes. Temperature fluctuations are largely damped at depths below 4 m in the bogs. With respect to mean sediment temperature, each lake is surrounded by a relatively warm rim. The annual heat budget of sediments at the shoreline in Tub Lake is 3,670 cal/sq cm; at a water depth of 8 m, it is 70 cal/sq cm. The mean annual budget for the entire sediments of Stewart's Dark Lake is 730 cal/sq cm, and for Tub Lake is 970. These values are about 10 and 12%, respectively, of the total annual heat budgets for the water in each lake. (Lang-USGS) W71-04608

CHEMICAL **COMPOSITION** PHYTOPLANKTON OF LAKES IN SOUTHERN ONTARIO,

Toronto Univ. (Ontario). Dept. of Botany.

J. H. Sparling, and C. Nalewajko.

Journal Fisheries Research Board of Canada, Vol 27, No 8, p 1405-1428, 1970. 10 fig, 4 tab, 34 ref.

Descriptors: *Water chemistry, *Phytoplankton, Descriptors: water chemistry, "Phytopiankton, *Lakes, Geology, Ecotypes, Scenedesmus, Cul-tivated lands, Magnesium, Nutrients, Algae, Diatoms, Conductivity, Hydrogen ion concentra-tion, Sodium, Potassium, Calcium, Chlorides, Bicarbonate, Electrolytes, Limestones, Cyanophyta, Chlorophyta, Chrysophyta. Identifiers: *Southern Ontario (Canada), Specie

associations

Water chemistry in southern Ontario lakes is determined primarily by surface and bedrock geology and impact of cultivation. Total dissolved solids give a poor indication of electrolyte content of lakes, because of the varied geology. Four lake types are recognized: base-poor lakes (Precambrian shield), moderately base-rich lakes (Bancroft-Rideau lakes region) related to more easily weathered rocks, base-rich lakes (Limestone region south of shield receiving drainage from cultivated land), and base-rich lakes with high levels of magnesium (draining from Silurian dolomitic limestone bedrock and dolomite-rich glacial tills). Phytoplankton populations were partially related to the chemical composition of lake waters. Tabellaria flocculosa and to a lesser extent Asterionella formosa and Dinobryon divergens were associated mainly with base-poor lakes. A larger number of species, including Synedra acus, Pediastrum duplex, Scenedesmus quadricausa, Cyclotella meneghiniana, Synedra ulna, and Cyclotella meneghiniana, Synedra ulna, and Cyclotella kutzingiana, were significantly associated with base-rich conditions. An association diagram for all species found showed groupings, mostly of species that prefer base-rich conditions. Few species confined to base-poor lakes were found to form associations. Apparent associations between oligotrophic species and species known to prefer eutrophic lakes are explained by the fact that nutrients were depleted during survey. (Jones-Wisconsin) W71-04618

PHYSICAL FACTORS WITH BEARING ON EUTROPHICATION IN LAKES IN GENERAL AND IN LARGE LAKES IN PARTICULAR,

Wisconsin Univ., Milwaukee. Center for Great Lakes Studies.

C. H. Mortimer.

Eutrophication: Causes, consequences. rectives. Printing and Publishing Office, National Academy of Sciences, Washington, D. C., p 340-368, 1969. 8 fig, 20 ref.

Descriptors: *Eutrophication, *Lakes, *Diffusion, Lake Michigan, Great Lakes, Hydrologic aspects, Oxidation-reduction potential, Temperature, Nutrients, Fluid mechanics, Activation energy, Stratification, Photosynthesis, Erosion, Iron, Coriolis force, Sediments, Manganese, Stratified flow, Hypolimnion, Epilimnion, Thermocline, Winds, Waves (Water), Currents (Water). Identifiers: *Large lakes.

Dynamics of diffusion, of oxygen balance, and of nutrient gains and losses affect biological production in natural waters. Nutrient influx is influenced by rock weathering, soil formation, and in drainage basin soil processes. Whichever way the surfacesediment layer becomes reduced by diffusion the effects, especially on subthermocline water mass are profound and associated not only with reduction and mobilization of iron and manganese and the unlocking of adsorbed materials, but also with the resultant removal of a barrier to unimpeded diffusion across the sediment-water interface. Although supply variations from drainage basin are not without influence, iron and manganese core profiles reflect the control of redox conditions. If lake basin is long enough or wind distrubance great enough, part of the hypolimnion will be raised into contact with the atmosphere and oxygen will be distributed to subthermocline levels. Recent findings indicate that both the forced motions (wind-driven currents) and the free motions (internal waves) are characterized by dominance of shore-parallel, quasi-geostrophic flow near shore and by frequent occurrence of rotating (inertial or near-inertial) flow off shore; this combination may lead to partial or temporary separation of characteristic coastal and offshore water masses, resulting in entrapment of nutrients. (See also W70-03975) (Jones-Wisconsin) W71-04620

LIMNOLOGICAL STUDIES ON LAKES IN THE DESCHUTES NATIONAL FOREST, OREGON. I. ODELL LAKE,

Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.

Douglas W. Larson.

Oregon State University, Corvallis, Water Resources Research Institute WRRI-4, 1970. 34 p, 9 fig, 9 tab, 21 ref. OWRR Project A-003-ORE (3).

*Lakes, *Oregon, Descriptors: *Limnology, *La Phytoplankton, Productivity, Nutrients, Seasonal, Zooplankton, Sampling, Dissolved solids, Soils, Pumice, Eutrophication, Oligotrophy, Geology, Climatic data, Bathymetry, Hydrogen ion concentration, Depth, Conductivity, Optical properties, Alkalinity, Calcium, Magnesium, Potassium, Sodium Daphnia, Chlorophyta, Photosynthesis, Chrysophyta, Chrysophyta, Florosynthesis, Ploussy, Phosphorus, Iron, Nitrates, Ammonia. Identifiers: *Deschutes National Forest (Ore),

*Odell Lake (Ore), Crater Lake (Ore), Lapillus.

The limnology of Odell Lake is documented prior to substantial deterioration by recreation. Recorded are phytoplankton standing stock and primary production measurements (considered unusually high for an oligotrophic lake) and

providing physical, chemical, and biological data to establish a reference point for periodic estimations of the effects of population impact. Temperature, light and nutrients appear to favor productivity. High production was sustained during summer and fall, with algal blooms not uncommon; large densities of zooplankton were observed. Concentration of total dissolved solids in Odell Lake was about 1/3 of Crater Lake, yet, production in Odell Lake was 8-10 times greater. Crater Lake contains six elements comprising 75% of total dissolved solids, suggesting that, although the value of total dissolved solids is relatively high, certain essential ions could be deficient. There is probably a better-balanced supply of ions in Odell Lake with none being deficient. The most salient feature of the soil profile was the large porosity and highly permeable nature of the underlying pumiceous layers, through which subsurface water percolation would be rapid. Lake usage has increased resulting in frequent pulses of phytoplankton and relatively high rate of primary production. (Jones-Wiscon-W71-04626

EUTROPHICATION IN LARGE LAKES AND IMPOUNDMENTS.

Uppsala Symposium, Sweden, May 1968. Organization for Economic Co-Operation and Development, Paris, 1970. 560 p, 124 fig, 40 tab, 222 ref, 7 photos, 15 append.

Descriptors: *Eutrophication, *Lakes, *Water pollution control, Water pollution effects, Water pollution sources, Impoundments, Nutrients, Priori-

ties, Resources, Programs.
Identifiers: *Case studies, *OECD, Policies, Public responsibility, Uppsala Symposium 1968, Scientific research, Water management, Lake Malaren, Lough Neagh, Lake Maggiore, Lake Constance, Lake Lugano, Laurentian Great Lakes, Oslo Fjord, Morecambe Bay Barrage (Netherlands).

This attractively published 566 pp volume in English and French covers the important aspects of its title. The synopsis of case studies, including lakes Malaren, Lough Neagh, Maggiore, Constance, Laurentian Great Lakes, and Oslo Fjord, presents one of the best 'introductions' to the problem of water eutrophication or pollution that is now facing the world. The section on research and management stresses that in the last analysis the 'eutrophication' or nutrient pollution is but one phase of the problem of water quality, a problem complicated by inert suspensions, poisons, reducing agents, oil, organic matter, hot water, radioactive substances, and pathogenic organisms. The discussion of current research and future needs provides a comprehensive review of urgent tasks and suggestions for future action. The second part of the volume of about 400 pp comprises detailed reports on the lakes mentioned in case studies and also reports on Morecambe Bay Barrage, Lake Lugano, and impoundments in the Netherlands. (See also W71-04631 thru W71-04639) (Wilde-Wisconsin) W71-04630

I. PRINCIPAL FEATURES IN THE CHEMIS-TRY OF LAKE MALAREN,

Thorsten Ahl.

In: Eutrophication in large lakes and impoundments, Uppsala Symposium, Sweden, May 1968. Organisation for Economic Co-Operation and Development, Paris, 1970. p 169-195. 22 fig.

Descriptors: *Lakes, *Water pollution sources, *Chemistry, Water pollution effects, Sampling, Water properties, Watershed (Basins), Precipitation, Acids, Air pollution, Geology, Nutrients. Identifiers: *OECD, *Uppsala Symposium 1968, Lake Malaren (Sweden), Sulphuric acid, Hydrochloric acid, Nitric acid.

Malaren is one of the largest and most irregularly shaped lakes of Sweden and presents a complex of water basins of widely different chemical and biotic

contents. The detailed investigation of this lake was begun in 1964 following alarming deterioration of water quality. The chemical analyses revealed a close relationship between the degree of eutrophication of different parts of the lake and geology of the basin and location of population centers. No less than bi-monthly sampling at 40.. stations provided information on water temperature, transparency, specific conductance, pH, and supply of nutrients. A record of nutrients discharged from important sub-watersheds, domestic sewage, and industrial waste provided an estimate of the lake's nutrient load. Recently, attention is given to acidification of precipitation, and, in turn, lake water by sulphuric, nitric, and hydrochloric acids supplied into the atmosphere by industry and agricultural fertilizers. (See also W71-04630) (Wilde-Wisconsin) W71-04631

THE BIOLOGICAL SECTION,

Torbjorn Willen.

In: Eutrophication in large lakes and impoundments, Uppsala Symposium, Sweden, May 1968. Organisation for Economic Co-Operation and Development, Paris, 1970. p 197-224. 25 fig.

Descriptors: *Lakes, *Eutrophication, *Biological communities, Water pollution effects, Water pollution sources, Nitrogen, Phosphorus, Pulp and paper industry, Physico-chemical properties.

Identifiers: *OECD, *Uppsala Symposium 1968, *Lake Malaren (Sweden), Anabaena, Gloeotrichia, Mercury.

Biological investigations of Lake Malaren and its contributing sources included determinations of bacteria, phytoplankton, C-14, chlorophyll, zooplankton, and fish. As far as it was possible, biological research was synchronized with physicochemical analyses. Sharp differences recorded in the local and seasonal distribution of phytoplankton, bottom fauna, and fish. The density of phytoplankton and content of chlorophyll were correlated with the supply of nitrogen and phosphorus. The catch of walleyed pike, pickerel, burbot, perch, and vendace varies locally from 2 to 6 kg/ha. Diagrams provide a comprehensive picture of biotic constituents in different sections of the lake reflecting the distribution of pollution centers. The differences in the eutrophication level of different bays are conspicuously revealed by blooms of Gloeotrichia and Anabaena spp. Particular attention is given recently to the inflow of mer-cury compounds, discharged by paper industry, and to the appearance of 'black list' waters in which the fish contains more than 1 mg mercury per kg and is avoided as food. (See also W71-04630) (Wilde-Wisconsin) W71-04632

LOUGH NEAGH.

In: Eutrophication in large lakes and impoundments, Uppsala Symposium, Sweden, May 1968.
Organisation for Economic Co-Operation and Development, Paris, 1970. p 227-296. 12 tab, 13 append.

Descriptors: *Lakes, *Eutrophication, *Water pollution sources, *Water pollution effects, Biological communities, Algal poisoning, Cost/benefit ratio, Sewage treatment, Analytical techniques, Biology, Ecology, Hydrology, Water pollution control.
Identifiers: *OECD, *Uppsala Symposium 1968,
*Lough Neagh (Ireland), Algal blooms.

This report provides a large volume of analytical data on ecology, biology, hydrology, and pollution of this large, rather shallow, and definitely eutrophic lake of northern Ireland. Investigations in this largest fresh water basin of the British Isles were initiated more than 50 years ago and assembled much information on phytoplankton, zooplankton, salmonoids, other fish, waterfowl, and charmonid flies. The combined effects of agricultural, industrial, and airborn pollution from the watershed of about 4,500 sq km produced in 1967 extensive blooms that killed fish and precluded cattle from drinking water. Subsequent analyses revealed that the toxicity was due to bluegreen alga Anabaena flos aquae, rather than a deficiency of oxygen. The cost/benefit ratio of ameliorations, possible toxicity of Anabaena to humans and animals, methods of treatment of sewage discharges, and control of algal blooms are the most pressing problems that confront the Government of Northern Ireland. (See also W71-04630) (Wilde-Wisconsin) W71-04633

REPORT ON LAKE MAGGIORE,

G. Bonomi, M. Gerletti, E. Indri, and L. Tonolli. In: Eutrophication in large lakes and impoundments, Uppsala Symposium, Sweden, May 1968. Organisation for Economic Co-Operation and Development, Paris, 1970. p 299-341. 10 fig. 9 tab.

Descriptors: *Lakes, *Eutrophication, *Water pollution sources, Water pollution effects, Political constraints.

*OECD, *Lake Maggiore, *Uppsala Identifiers: Symposium 1968, Algal blooms, Tabellaria fenestra, Oscillataria rubescens.

The geographic location destined the Lago Maggiore to serve as the final receptacle of domestic sewage and industrial discharges from 6600 sq km watershed of Italy and Switzerland. In spite of this, the average depth of 180 meters has thus far kept the concentrations of organic matter, nitrogen, and phosphorus near the oligotrophic-mesotrophic boundary. The fact that a large part of the drainage basin does not permit cultivation is an important contributing feature. The distribution of planktons in this 65 km long, but rather narrow lake is strongly influenced by the pattern of settlement, nature of tributary waters, and thermal characteristics. The estimates of primary productivity for the entire lake vary from 140 to 175 g carbon sq m/yr. The oxygen content in the deep layers is still satisfactory, but the blooms of Tabellaria fenestra and the first bloom of Oscillataria rubescens in 1967 are the 'alarm bells' of eutrophication. Also, infection of fish by bacteria, fungi, viruses, and tapeworms indicates the hazard of sewage pollution. While the distribution of oxygen and planktonic, benthic, and fish biocoenose provides an adequate record of the health conditions of the lake, the management of the system encounters engineering, social, and political difficulties. The latter may be particularly pronounced when the body of water is in the possession of two different States. (See also W71-04630) (Wilde-Wisconsin) W71-04634

WATER QUALITY MAINTENANCE OF LAKE CONSTANCE. International Water Protection Commission for

In: Eutrophication in large lakes and impoundments, Uppsala Symposium, Sweden, May 1968. Organisation for Economic Co-Operation and Development, Paris 1970. p 345-357. 5 fig.

Descriptors: *Lakes, *Eutrophication, *Water pollution sources, *Water pollution effects, International commissions, Water quality control, Sewage treatment.

Identifiers: *Lake Constance, *OECD, *Uppsala Symposium 1968, Germany, Austria, Switzerland.

The Obersee-Untersee twins of Lake Constance serve as storage basins for waters contributed by the uplands of Germany, Austria, and Switzerland. Unfortunately, aside from water, the lake receives sewage and wastewater of the shore communities of the three Republics. The state of eutrophication of different parts of the lake is instructively illustrated by a color map showing four degrees of pollution. The deterioration of water quality threatens the survival of the 'Felchen,' a salmonid of an exceptionally delicate taste, and other fish totaling 4,000 ton annual catch. Following prolonged negotiations, in 1960 the three bordering states signed an international agreement of anti-pollution measures, an act which alone can promise success of water protection. The experts of the International Commission for Lake Constance digested the results of previous investigations and greatly enlarged the scope of research. The results of analyses indicated that the sewage phosphorus is the main cause of the biological deterioration of the lake. In consequence, a diversified program of sewage purification is now in the state of progres materialization. (See also W71-04630) (Wilde-Wisconsin) W71-04635

LAKES AND IMPOUNDMENTS IN THE NETHERLANDS.

In: Eutrophication in large lakes and impoundments, Uppsala Symposium, Sweden, May 1968. Organisation for Economic Co-Operation and Development, Paris, 1970. p 555-560.

Descriptors: *Lakes, *Canals, *Eutrophication, Water management (Applied), Water pollution effects, Water pollution control, Fish, Reaeration, Potable water, Desalination, Water purification, Artificial recharge, Groundwater recharge, Water

Identifiers: *OECD, *Uppsala Symposium 1968, Boezems, Holland.

The 'boezems' of interconnected canals and lakes form the unique artificially controlled water system of Holland. The water levels in these networks are maintained by sluices and powerful pumping stations. Continuous flushing is used to reduce pollution and salt content of brackish seepage. Flushing with fresh water of IJssellake and Rhine decreases the salinity of the boezems, but not the degree of water eutrophication; IJssellake receives an enormous input of phosphorus and the Rhine is loaded with nutrients. In turn, the growth and blooms of Asterionella formosa, Anabaena spiroidia, and other algae hinder fish life and recreational activities, and require intensive purification of water for either drinking or industrial purposes. Improvement in the supply and quality of water is sought in artificial recharge of groundwater and storage of surface water in large reservoirs. Some isolated sand and gravel borrow-pits preserve water of ex-cellent quality. Recent trials demonstrated that airbubble injections raise deep saline water and alleviate anaerobic conditions of hypolimnia. (See also W71-04630) (Wilde-Wisconsin) W71-04636

THE INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES; A PROGRAM OF SYNOPTIC STUDIES OF A LARGE LAKE,

L. A. Heindl, and I. C. Brown.

In: Eutrophication in large lakes and impoundments, Uppsala Symposium, Sweden, May 1968. Organisation for Economic Co-Operation and Development, Paris, 1970. p 383-389. 1 tab.

Descriptors: *Lakes, *International Hydrological Decade, *Lake Ontario, Synoptic analyses, Hydrologic aspects, Meteorological data, Water balance, Heat balance, Water circulation, International commission, Foreign countries, Standards, Data collections

Identifiers: *OECD, *Uppsala Symposium 1968, IFYGL.

In the early 60's hydrologists all over the world came to realize the crucial need for information on the quality of natural waters and management of water resources. Nearly 100 nations banded together in a 10-year program of hydrological research, designated as the International Hydrological Decade. The IHD found strong support in the USA and Canada, and the first joint effort of the two countries found its expression in the International Field Year for the Great Lakes (IFYGL).

Field 02—WATER CYCLE

Group 2H-Lakes

The proposed field year activity is to be confined to the Lake Ontario, its meteorology, terrestrial water balance, heat balance, and water movement. Analyses and preparation of reports would be extended through 1973. The Steering Committee will provide direction to the program, and operational coordination will be effected by specialists em-ployed by the Inland Water Branch of Canada and US Corps of Engineers. The operational procedure in each country, however, will be in accord with their practices. (See also W71-04630) (Wilde-Wisconsin) W71-04637

OF LAKE THE **EUTROPHICATION** MICHIGAN,

John C. Ayers In: Eutrophication in large lakes and impoundments, Uppsala Symposium, Sweden, May 1968. Organisation for Economic Co-Operation and Development, Paris, 1970. p 399-408. 7 tab, 15 ref.

Descriptors: *Lakes, *Lake Michigan, *Eutrophication, Water pollution effects, Dissolved solids, Nitrogen, Phosphorus, Fish, Algae, Lampreys, Calcium carbonate, Winds, Mixing, Thermal stratifica-tion, Thermocline, Isotherms.

Identifiers: *OECD, *Uppsala Symposium 1968, Algal blooms, Cladophora, Alewife, Milky water, Thermal bar.

The eutrophication of Lake Michigan is probably most strongly pronounced in the vicinity of Chicago. In this region, the content of total dissolved solids has risen during the past 75 years from 130 to 170 ppm. Nitrogen and phosphorus concentrations have now reached the nuisance-algaebloom level. Since 1926 the phytoplankton increased annually at a rate of 13 organisms per millimeter. Recently Cladophora polluted 6 public beaches. The records of fish and zooplankton were distorted by immigrant species, such as sea lamprey and alewife. The main body of Lake Michigan is not easily assessed, but studies of the last 40 years revealed significant changes in zooplankton, formation of marl in epilimnion, increased turbidity, and a reduction in hypolimnic oxygen. In recent years, formation of calcium carbonate crystals produced milky water color which very likely reduces the depth of the euphotic zone and diminishes the content of near-bottom oxygen. The distribution of the inshore pollutants through the main body of the lake is accomplished largely by winter wind mixing and migration of the 'thermal bar,' the spring equalization of water masses having temperature above and below 4 degree C. The waters injected into the main body epilimnion by rotation of 4 degree isotherm support high phytoplankton and produce blooms after the thermal stratification is completed. (See also W71-04630) (Wilde-Wisconsin) W71-04638

RECENT DEVELOPMENTS AND PRESENT-DAY SITUATION IN RELATION TO THE LAKE OF LUGANO AND ITS TRIBUTARIES,

Otto Jaag, and Erwin Marki.

In: Eutrophication in large lakes and impoundments, Uppsala Symposium, Sweden, May 1968. Organisation for Economic Co-Operation and Development, Paris, 1970. p 533-551. 13 fig, 4 tab.

Descriptors: *Lakes, *Eutrophication, Water pollution effects, Water pollution sources, Water pollution control, Fishkill, Fish harvests, Sewage, In-

dustrial wastes, Sewage treatment.
Identifiers: *OECD, *Uppsala Symposium 1968, Oscillatoria rubescens.

The two-thirds Swiss and one-third Italian Lake Lugano exhibited symptoms of malady as early as 1889, the year of the first dramatic fish kill. Investigations during the past 20 years were largely conducted in response to the progressively declining fish harvests. Research revealed one of the reasons for the biological deterioration of the lake is a continuous reduction in the hypolimnic oxygen

concentration. The average oxygen content at the end of summer stagnation at a depth of 50 m had decreased from 7.4 mg/l in 1946 to 4.1 mg/l in 1964. The unfavorable alteration in the chemical composition of the lake is attributed to the inflow of domestic sewage and industrial waste water that induced lush development of Oscillatoria rubescens. Some improvement in water quality is expected following the construction of a purification sewage plant for the City of Lugano. (Wilde-Wisconsin) W71-04639

LIMNOLOGY OF TWO RE-REGULATION RESERVOIRS IN SZECHOSLOVAKIA, Ceskoslovenska Akademie Ved,

Hydrobiologicka Lab. Milan Straskraba, and Pavel Javornicky. Typescript. 69 p, 34 fig.

Descriptors: *Limnology, Reservoirs, Hydrologic aspects, Biological properties, Epilimnion, Temperature, Energy, Surface waters, Water tempera-Mathematical models, Phytoplankton, Zooplankton, Photosynthesis, Chlorophyll, Primary productivity, Oxygen.

An empirical model of annual temperature cycles is developed for Vltava Cascade Reservoirs. During a two year study and evaluation of 10 years of data the temperature change within the poorly stratified water body of the re-regulation reservoir, fed from the hypolimnion of the power - generation reservoir, was found to correlate well with the air - water temperature gradient and retention time. A second order sine curve proved to express adequately the annual temperature cycles within the Cascade reservoirs. The species composition, abundance and standing crop of phyto-and zooplankton, as well as the chlorophyll-a content and photosynthetic activity of phytoplankton, are explained for the conditions of the reservoirs. The upper reservoir resembles arctic lakes as to phytoplankton activity. (Novotny-Vanderbilt) W71-04717

SOME MICROBIAL-CHEMICAL INTERAC-TIONS AS SYSTEMS PARAMETERS IN LAKE ERIE.

Ohio State Univ., Columbus. Microbial and Cellular Biology. For primary bibliographic entry see Field 06A.

W71-04758

DEVELOPMENT OF AN OXYGEN-BASED PER-FORMANCE MODEL FOR THE WESTERN LAKE ERIE PHYSICO-BIOLOGICAL SYSTEM, Ohio State Univ., Columbus. Dept. of Microbiolo-

For primary bibliographic entry see Field 06A. W71-04759

PRELIMINARY POLICY MODELS FOR GREAT

LAKES REGULATION, Cornell Univ., Ithaca, N.Y. Dept. of Water Resources Engineering. For primary bibliographic entry see Field 06A.

W71-04760

ECOLOGICAL MODELING RESEARCH IN THE GREAT LAKES,

Michigan Univ., Ann Arbor. Dept. of Wildlife and Fisheries; and Michigan Univ., Ann Arbor. Dept. of Civil Engineering. For primary bibliographic entry see Field 06A.

W71-04780

2I. Water in Plants

VASCULAR AQUATIC PLANTS IN ACID MINE MONONGAHELA THE OF WATER RIVER, WEST VIRGINIA,

West Virginia Univ., Morgantown. Water Research

For primary bibliographic entry see Field 05C. W71-04418

2.J. Erosion and Sedimentation

SURF-BEAT ORIGIN FOR PULSATING BOTTOM CURRENTS IN THE RIO BALSAS SUBMARINE CANYON, MEXICO, Geological Survey, Menlo Park, Calif.

Erk Reimnitz.

Geological Society of America Bulletin, Vol 82, No 1, p 81-89, January 1971. 9 p, 5 fig, 10 ref.

Descriptors: *Surf, *Erosion, *Rip currents, *Ocean waves, *Canyons, Estuaries, Rivers, Sediment transport, Bed load, Channels, Streamflow, Currents (Water).

Identifiers: *Surf-beat current pulses, *Submarine canyons, *Mexico.

At the head of a tributary to the Rio Balsas sub-marine canyon system in Mexico, during a period of large surf, river discharge deflected a pulsating longshore current (peaking at over 7 km/hr) seaward over the tributary heading in the surf zone. This pulsating flow occasionally entered the river mouth, causing rhythmic fluctuations with amplitudes of at least 30 cm and a period of about 3 minutes within the mouth, as recorded by a partially filtered tide gage. Current pulses with estimated velocities of 4 km/hr transport large amounts of suspended sand down an axial slope of 26 deg. This bottom flow was at least 3 m thick, and was characterized by pulses separated by quiet periods in phase with the surface rip current. Estimated water budget suggested that the entire water column below the rip current at 18 m was not flowing seaward during the pulses. The magnitude of the flow was sufficient to erode the canyon walls. These observations substantiate that rip currents play a role in the formation of some submarine canyons. (Knapp-USGS) W71-04352

AN EVALUATION OF PROCEDURES USED IN COMPUTING CHEMICAL DENUDATION RATES.

Geological Survey, Menlo Park, Calif. For primary bibliographic entry see Field 02K. W71-04353

COASTAL LANDFORMS: CRESCENTIC AND RHYTHMIC,

Virginia Univ., Charlottesville. Robert Dolan.

Geological Society of America Bulletin, Vol 82, No 1, p 177-180, January 1971. 4 p, 4 fig, 14 ref.

Descriptors: *Beaches, *Sediment transport, *Sand waves, *Beach erosion, North Carolina, Geomorphology, Currents (Water), Rip currents, Coasts, Dunes, Littoral drift, Surf, Waves (Water), Storms

Identifiers: *Coastal landforms.

Crescentic shoreline landforms are common along many sandy coasts. Some of these migrating rhythmic forms reflect interacting processes and systematic bar-and-trough configurations within the surf zone. The rate of migration along the coast is greater during the stormy winter season. These forms must be better understood for more efficient engineering and experimental design. (Knapp-USGS) W71-04354

Erosion and Sedimentation—Group 2J

FRESH WATER IRON-MANGANESE NODULES IN LAKE GEORGE, NEW YORK,

Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of

For primary bibliographic entry see Field 02K. W71-04355

MECHANICAL COMPACTION OF SANDS CONTAINING DIFFERENT PERCENTAGES OF DUCTILE GRAINS: A THEORETICAL AP-PROACH,

Shell Oil Co., Houston, Tex. For primary bibliographic entry see Field 02F. W71-04360

ESTIMATION OF BASIC CHARACTERISTICS

OF MUDFLOWS ('SEL'),
Nauchno-Issledovatelskii
Nauchno-Issledovatelskii Gidrometeorologicheskii Institut, Tiflis (USSR).

I. I. Kherkheulidze.
In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 940-948, 1969. 9 p, 2 tab, 9 ref.

Descriptors: *Mudflows, *Sediment transport. *Rainfall-runoff relationships, Storm runoff, Open channel flow, Mud, Sediment load. Identifiers: USSR, Sels.

A method for estimation of maximum discharge and volumes of liquid and solid mudflows (sel) is discussed. The volume of the sel may greatly exceed the volume of the initial rainfall or snowmelt runoff, depending upon the degree of porosity and preliminary water saturation of friable soils on the watershed. The possible limits of solid content of the sel are discussed, giving as characteristic examples two watersheds in the Alps and a watershed in the Caucasus. The relationships of the maximum and mean velocity of sels and their width, denth and total static and dynamic pressure on obstacles are given. The proposed relationships result from elementary analysis of the two-phase soil and water system and from correlation analysis of 40 actual measurements. Maximum velocities of sels ranged from 14.0 to 22.0 m/sec., volumetric weight from 1.67 to 2.29 t/cu m, mean stream depth from 0.10 to 11.2 m and longitudinal channel slope from 3.8 to 26%. (Knapp-USGS) W71-04415

RECENT VARIATIONS IN COURSE AND REGIMEN, KANSAS RIVER AND NEARBY REACHES OF MISSOURI RIVER, Kansas Water Resources Research Inst., Manhat-

tan.
Wakefield Dort, Jr., and John R. Ratzlaff.
Available from NTIS as PB-197 593, \$3.00 in paper copy, \$0.95 in microfiche. Completion Report, Kansas Water Resources Research Institute, Manhattan, Contribution No 50, (1970). 51 p, 10 tab, 8 fig, 51 ref, append. OWRR Project No A-025-KAN(1).

Descriptors: *Erosion, *Sediment load, Sedimentation, Sediments, *Channel morphology, Stream erosion, Precipitation, Discharge measurement. Identifiers: Channel patterns, Cultivation, Stream discharge, *Kansas River, *Missouri River.

Changes in stream morphology can be deterministic (alterations of variables within the physical system by climatic or cultural influences and effects) or probabilistic (random processes). It may be difficult or impossible to isolate and identify specific cause and effect relationships. Evaluation of changes in channel pattern and sinuosity of the Kansas River involves the selection of data of appropriate quantity and quality. Data for channel pattern and stream discharge, which constitute an empirically-derived functional relationship, best meet the requirements. Stream discharge, through its association with precipitation, is investigated on a time scale of several decades. Annual discharge before these measurements were recorded is estimated indirectly from annual precipitation computed as a representative figure for the entire drainage basin. Settlement and cultivation accelerated erosion and resulted in increased sediment loads supplied to the river. The significance of this change is discussed along with other possible factors. The channel lengths and gradients upstream and downstream from the study area are studied. An interpretation of the configuration and behavior of the river prior to 1950 is presented.

ESTIMATING SUSPENDED SEDIMENT CON-CENTRATIONS IN STREAMS BY TURBIDITY MEASUREMENTS,

Agricultural Research Service, Danville, Vt.; and Agricultural Research Service, Beltsville, Md. Hydrograph Lab. For primary bibliographic entry see Field 07B.

W71-04560

BIOTURBATION OF SEDIMENTS IN A NORTHERN TEMPERATE ESTUARY.

Chicago Univ., Ill. Dept. of the Geophysical Sciences; New Hampshire Univ., Durham. Jackson Estuarine Lab.; and New Hampshire Univ., Durham. Dept. of Earth Sciences.

For primary bibliographic entry see Field 02L. W71-04561

RATES AND MODES OF DENUDATION. WHITE MOUNTAINS, EASTERN CALIFORNIA, Bucknell Univ., Lewisburg, Pa. Dept. of Geology and Geography; and Geological Survey, Washing-

Denis E. Marchand.

American Journal of Science, Vol 270, No 2, p 109-135, February 1971. 27 p, 7 fig, 8 tab, 33 ref.

Descriptors: *Erosion, *Weathering, *Leaching, *California, Stream erosion, Sheet erosion, Geomorphology, Hydrogeology, Geochemistry, Water chemistry, Vegetation effects.

Identifiers: *Erosion, rates *White Mountains Identifiers: *Erosion rates, *White Mountains

Long-term total erosion rates in the White Mountains, estimated from depths of removal beneath a 10.8-m.y.-old basalt, range from 1 to 3 cm per 1000 years. Present rates of chemical denudation, corrected for contributions from the atmosphere and biosphere, are 0.14 to 0.19 cm per 1000 years in dominantly adamellite terrain and 1.7 to 2.1 cm per 1000 years in areas underlain by Reed Dolomite. These figures are much lower than Reed Dolomite denudation rates estimated from botanical evidence in the same area (LaMarche, 1968) but are consistent with erosion rates in the nearby Sierra Nevada. Chemical denudation by plant uptake and litter erosion was evaluated and compared with removal in solution. Although total amounts of biogeochemical erosion do not appear to be significant, this process may account for some part of the extraction of P and K and is apparently responsible for appreciable portions of Al, Fe, and Mn denudation. In stream waters draining dolomite, partial pressures of CO2 exceed values for air and adamellite-derived waters by over an order of magnitude. These differences are ascribed to biological factors rather than to solution of carbonate minerals. (Kmapp-USGS) W71-04562

MASS PHYSICAL PROPERTIES AND SLOPE STABILITY OF SEDIMENTS OF THE NORTHERN MIDDLE AMERICA TRENCH, Woods Hole Oceanographic Institution, Mass. David A. Ross.

Journal of Geophysical Research, Vol 76, No 3, p 704-712, January 20, 1971. 9 p, 7 fig, 31 ref. ONR Contract N00014-66-C-0241.

Descriptors: *Bottom sediments, *Physical properties, *Slope stability, *Continental shelf, Pacific Ocean, Clay minerals, Particle size, Moisture content, Sampling, Clays, Silts, Porosity, Shear strength, Density, Cores. Identifiers: Middle America Trench.

The mass physical properties (shear strength, porosity, and density) of 32 cores from the northern part of the Middle America Trench have been determined. A stability analysis using the shear strength data (determinations made with a vane shear device) indicate that the sediments are generally stable except on the landward flank of the trench where slumping is possible under the slope conditions observed. Comparisons of gravity-piston core pairs indicate differences in porosity and shear strength that are the result of the coring procedure. The corer used in this study was designed to minimize sample disturbance, but better coring devices are needed before in situ conditions are approached. Porosity and the log of shear strength are inversely related, and porosity has a positive relationship to clay content. The specific gravity of the sediments is 2.66 gm/cc (at zero proosity), a value similar to that of other areas with a high rate of terrigenous deposition. (Knapp-USGS) 71-04566

THE MECHANICS OF SAND TRANSPORT ON

BEACHES, Scripps Institution of Oceanography, La Jolla,

Paul d. Komar.

Journal of Geophysical Research, Vol 76, No 3, p 713-721, January 20, 1971. 9 p, 3 fig, 14 ref.

Descriptors: *Sediment transport, *Beaches, *Littoral drift, *Ocean waves, Ocean currents, Shores, Waves (Water), Sands.

Identifiers: Beach sediment transport.

On steep-faced beaches where waves break and swash at an angle to the shoreline, the littoral drift of beach material results from the saw-tooth motions of the sediment in the longshore direction. The sand moves forward obliquely to the shore under the incoming wave swash and then moves normal to the shoreline under the return flow. For such transport conditions a rational derivation leads to a relationship using a function of the angle the breaking wave makes with the shoreline. This often applied relationship, previously only intuitive, is rigorously established for special saw-tooth transport and applies also when the sediment is transported by a longshore current proportional to the orbital velocity under the breaking waves. These are the two most important mechanisms by which sediment is transported along the shore under wave action. The profiles of variation of the longshore sand transport as a function of the distance seward of the swash line are examined theoretically. The results conform with the field observations. (Knapp-USGS) W71-04567

STOCHASTIC MODEL FOR SAND DISPER-

Illinois Univ., Urbana. Water Resources Center; Illinois State Water Survey, Urbana; and Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics. Chih Ted Yang, and William W. Sayre.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY2, Paper 7892, p 265-288, February 1971. 24 p, 16 fig, 2 tab, 10 ref, append.

Descriptors: *Sediment transport, *Mathematical models, *Stochastic processes, *Dispersion, Open channel flow, Model studies, Hydraulic models, Statistical methods, Probability, Char morphology, Sedimentary structures, Bed load. Identifiers: Sand dispersion. Channel

The movement of sand particles is expressed in terms of steps and rest periods. The longitudinal dispersion of sand particles along the bed of an alluvial channel is formulated in a general one-dimensional stochastic model. Three different methods are suggested for determining the three parameters in the stochastic model. Experimental

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results indicate that the step lengths follow a gamma distribution and that the rest periods follow an exponential distribution. Statistical analysis of bed configuration indicates the movement of sand particles along an alluvial bed should be closely related to the statistical properties of the bed configuration. The results of longitudinal dispersion experiments compare favorably with predications based on the stochastic model. (Knapp-USGS)

SABELLARIA REEF MASSES IN DELAWARE

Delaware Univ., Newark. Dept. of Biological Sciences; and Delaware Univ., Newark. Marine Lab.

For primary bibliographic entry see Field 02L.

W71-04588

PORTABLE RADIOISOTOPE GAUGES FOR SUSPENDED SEDIMENTS,

International Atomic Energy Agency, Vienna (Austria).

T. Florkowski.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/34, p 545-554, 1970. 10 p, 6 fig.

Descriptors: *Sediment load, *Suspended load, *Nuclear meters, *Gamma rays, Instrumentation, Calibrations, Radioactivity techniques, Soil density probes, Sedimentation, Sediment transport. Identifiers: *Nuclear sediment meters, *Gamma backscatter probes.

A new type of gage for measurement of suspended sediments is described. A gage with a Am-241 radioisotope source used attenuation of scattered gamma photons as a measure of sediment concentration. A theoretical and semi-empirical approach to the design of the instrument is discussed, including the influence of chemical composition of the sediment. A practical method for correcting a laboratory made calibration curve for the changes of chemical composition of the sediment is proposed for the new probe and for the absorption-type Cd-109 probe. Field tests of the probes in different conditions are evaluated. (Knapp-USGS) W71-04595

TURBIDIMETRY: MEASUREMENT OF X- OR GAMMA-ABSORPTION OR MEASUREMENT OF NATURAL RADIOACTIVITY (FRENCH),

OF NATURAL RADIOACTIVITY (FRENCH),
Commissariat a l'Energie Atomique, Saclay
(France). Centre d'Etudes Nucleaires.
G. Courtois, F. Anguenot, and C. Magloire.
In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and
UNESCO, Vienna, March 9-13, 1970: Vienna, In-

ternational Atomic Energy Agency STI/PUB/255, Paper No SM-129/35, p 555-580, 1970. 26 p, 11 fig, 2 tab, 8 ref.

Descriptors: *Sediment load, *Suspended load, *Nuclear meters, *Gamma rays, Instrumentation, Calibrations, Radioactivity techniques, Soil density probes, Sedimentation, Sediment transport, Clays, Silts.

Identifiers: *Nuclear sediment meters, *Gammaray probes.

Turbidity may be measured by radioactive means on the basis of the two following methods: (a) measurement of gamma absorption in a nuclear gage, corresponding to a measurement of the density of the medium; (b) in-situ measurement of the natural radioactivity of the sediment in suspension. The two methods were evaluated simultaneously by using a gamma absorption gage (Am-241) and by carrying out in-situ measurements of natural radioactivity of sediment in suspension. The advantages and disadvantages of each of these two methods are critically analyzed. It would appear, in particular that the natural radioactivity gage is much less sensitive to local salinity and is a valuable tool in estuaries of variable salinity and of generally high turbidity, and that being stronger and simpler, it is less sensitive to different parameters (electronic drifts, geometric variations, etc). On the other hand, it must be calibrated for each site and periodically on the same site. Further, it can only be used in a clayey medium. Particulars are given for the use of each of these instruments. (Knapp-USGS) W71-04596

THE MASS OF LABELLED INJECTION SEDI-MENTS FOR USE IN A RADIOACTIVE TRACER EXPERIMENT IN DYNAMIC SEDI-

MENTOLOGY (FRENCH), Commissariat a l'Energie Atomic (France). Centre d'Etudes Nucleaires. Atomique, Saclay

G. Courtois, and G. Sauzay. In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/36, p 581-616, 1970. 36 p, 19 fig, 4 ref.

Descriptors: *Sediment transport, *Bed load, *Tracking techniques, *Tracers, *Tagging, Instrumentation, Nuclear techniques, Sands. Radioactivity meters. Identifiers: *Bed load tracers.

A general theory is given of detector response variation and of the probability associated with each value of that response when the number and distribution of the radioactive sources in a given volume vary while the activity remains constant. The theory is applied to the problem of detecting a cloud of tracers in sedimentology experiments. First, the calculation is made with a tracer distributed at the surface of the bed for a sand of uniform grain size and for a given detector of known geometric response. Static detection of the cloud and then a dynamic detection (probe pulled along the bed) were studied. In both cases the minimum mass of tracer per unit of activity which has to be immersed in order to obtain a fluctuation in the count-rate due to the change in position of the radioactive grains, equivalent to 30% of the mean count-rate were determined. General formulae take these parameters into account and can be used for determining the quantities of sand for immersion as a function of the measurement parameters and of the characteristics of the sediment. Dynamic detection requires a quantity of tracer per unit ten times smaller than for static detection, the latter in turn requiring ten times less tracer than a core-sampling analysis. (Knapp-USGS) W71-04597

2K. Chemical Processes

AN EVALUATION OF PROCEDURES USED IN COMPUTING CHEMICAL DENUDATION

Geological Survey, Menlo Park, Calif. Richard J. Janda.

Geological Society of America Bulletin, Vol 82, No 1, p 67-79, January 1971.13 p, 1 fig, 2 tab, 47 ref.

Descriptors: *Weathering, *Erosion, *Solutes, *Dissolved solids, Leaching, Water pollution effects, Erosion, Bicarbonates, Sulfates, Chlorides, Nitrates, Silica.

Identifiers: *Chemical denudation, *Erosion (Chemical).

Computations of chemical denudation rates should be based only upon those components of dissolved loads of streams that are derived from chemical weathering of rocks and soils, even though identification of those components is difficult and imprecise. Past computations of chemical denudation rates exaggerated by 1.4 to 2.4 times the significance of this process because they were calculated from total dissolved loads. In crystalline silicate rock terrane, commonly 25 to 55% of the dissolved solids are HCO3, SO4, Cl and NO3, that cannot be derived from the underlying rock; instead these ions are derived either directly from the atmosphere or from atmosphere-biosphere interactions. Atmospheric contributions to dissolved loads of dilute natural waters are substantial. Concentration of natural solutes represents a modification of natural denudation processes that does not change the rate of denudation. Addition of new solutes represents man-induced, accelerated chemical denudation. (Knapp-USGS) W71-04353

FRESH WATER IRON-MANGANESE NODULES IN LAKE GEORGE, NEW YORK, Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of

Geology.

Manfred Schoettle, and Gerald M. Friedman. Geological Society of America Bulletin, Vol 82, No 1, p 101-109, January 1971. 9 p, 10 fig, 2 tab, 32

Descriptors: *Sedimentation, *Manganese, *Lakes, *New York, *Chemical precipitation, Water chemistry, Mineralogy, Iron, Bottom sediments, X-ray analysis, Geochemistry. Identifiers: *Manganese nodules, *Lake George

Lake George, New York, is the site of a new discovery of iron-manganese nodules. These nodules occur at a water depth between 21 and 36 m along a stretch of lake extending for about 5 mi north and south of the Narrows, a constricted island-dotted area which separates the north and south Lake George basins. Nodules occur on or within the uppermost 5 cm of a varved glacial clay. The Lake George nodules are enriched in iron with respect to marine nodules but are lower in manganese. They have a higher trace element concentration than nodules from other known freshwater lake occurrences, but a lower concentration than marine nodules. (Knapp-USGS) W71-04355

ADSORPTION OF ISOCIL AND BROMACIL FROM AQUEOUS SOLUTION ONTO SOME MINERAL SURFACES,

Oregon State Univ., Corvallis. Dept. of Agricultural Chemistry; and Oregon State Univ., Corvallis. Environmental Health Sciences Center. For primary bibliographic entry see Field 05B. W71-04356

ESTIMATION OF ADSORBABLE SOLUTES IN SEAWATER WITH C-LABELLED PHENOL AND ACTIVATED CARBON,

Woods Hole Oceanographic Institution, Mass. For primary bibliographic entry see Field 05A. W71-04357

CONTINUOUS EXTRACTION OF ORGANIC

MATERIALS FROM WATER,
Geological Survey, Denver, Colo; and Federal
Water Quality Administration, Edison, N.J.
For primary bibliographic entry see Field 05A. W71-04358

CHEMICAL. QUALITY OF MICHIGAN

STREAMS, Geological Survey, Washington, D.C. Warren W. Wood.

Geological Survey Circular 634, 1970. 21 p, 12 fig, 1 tab, 20 ref.

Descriptors: *Water quality, *Surface waters, *Michigan, *Hydrologic data, *Data collections, Streams, Chemical analysis, On-site tests, Laboratory tests, Water resources development, Stream-flow, Discharge measurement, Water temperature, Geology, Geochemistry, Water chemistry, Water pollution sources. Identifiers: *Michigan streams (Chemical quality).

To aid in defining the chemical quality of stream waters in Michigan, samples were collected at approximately 200 gaging stations. One series of samples was collected in late March and early April 1967 when streamflow was high. The second set was collected in late August and early September 1967 under conditions of low streamflow. All measured parameters illustrate distinct regional patterns of distribution that shift only slightly under conditions of high and low flow. Water in the streams is of the calcium magnesium bicarbonate type and remains this type under high- and low-flow conditions. Concentrations of dissolved substances are generally lower during periods of high flow than during periods of low flow. The higher concentrations that occasionally occur at spring high flows are attributed to inflow of water from combination of effluent from sewers, fertilizers, and possibly road salt. Considering all parameters, there is a distinct tendency for the most dilute water to appear in the northern peninsula. (Woodard-USGA) W71-04362

SALTY GROUNDWATER IN THE POCATAL-

ICO RIVER BASIN, Geological Survey, Morgantown, W.Va. For primary bibliographic entry see Field 05B. W71-04368

BROMIDE AND IODIDE IN OILFIELD BRINES IN SOME TERTIARY AND CRETACEOUS FOR-MATIONS IN MISSISSIPPI AND ALABAMA, Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.

For primary bibliographic entry see Field 02F W71-04417

CONJUGATED ADDITIONS IN HYDROGEN FLUORIDE, (IN GERMAN), Akademiya Nauk SSR, Moscow. Institut Elementoorganicheskikh Soedinenii.

L. S. German, and I. L. Knunyantz. Angewandte Chemie, Vol 81, No 9, p 321-328,

Descriptors: *Water properties, *Chemical reactions, *Chemical properties, *Halogens, Ethers, Alcohols.

Identifiers: *Hydrogen fluoride, Conjugated additions, Secondary reactions, Esters, Beta-fluoral-cohol, Oxonium ions, Hypofluoridation.

By entering into a reaction with CC-double bond, the water-free hydrogen fluoride can give rise to many new compounds, such as alpha-fluoride, beta-halogen, beta-alkyl, beta-nitro- and beta-amino compounds. The secondary reactions may produce fluorized ether, alcohol, ester, and carbonic acids. The 'hypofluoridation' in the presence of oxonium ions may yield beta-fluoralcohol. (Wilde-Wisconsin) W71-04525

RADIOACTIVITY IN CALIFORNIA WATERS JULY-DECEMBER 1968.

California State Dept. of Public Health, Berkeley. Bureau of Radiological Health.

For primary bibliographic entry see Field 05B. W71-04530

TEMPORAL DISTRIBUTIONS OF RADIOAC-TIVITY AND Sr-89/Sr-90 RATIOS DURING RAINSTORMS,

Arkansas Univ., Fayetteville. Dept. of Chemistry. For primary bibliographic entry see Field 02B. W71-04563

DEEP-SEA IN SITU CALCIUM CARBONATE SATUROMETRY,
California Univ., Los Angeles. Dept. of Geology; and California Univ., Los Angeles. Geophysics and

For primary bibliographic entry see Field 07B. W71-04568

CHEMICAL PROCESSES AT THE AIR-SEA IN-TERFACE: THE BEHAVIOR OF FLUORINE,

Naval Research Lab., Washington, D.C. P. E. Wilkniss, and D. J. Bressan.

Journal of Geophysical Research, Vol 76, No 3, p 736-741, January 20, 1971. 6 p, 3 tab, 14 ref.

Descriptors: *Water chemistry, *Sea water, *Airwater interfaces, *Ion exchange, Sprays, Evapora-tion, Aerosols, Bubbles, Surf, Waves (Water), Winds, Chlorides, Fluorides. Identifiers: *Ion fractionation.

Ion fractionation between fluorine and chlorine at the air-sea interface was investigated. Radiochemical experiments showed a decrease in the F/Cl ratio for laboratory aerosols produced from sea water. Marine aerosols showed an increase in the F/Cl ratio with a possible contribution from airborne dust contamination. Jet drops in the laboratory and naturally occurring marine jet drops showed little to no change. Radiochemical tracers also showed that drying of sea water droplets would sometimes increase the F/Cl ratio of the salt residue, whereas acidification of the sea water always caused the residue to have a decreased ratio. (Knapp-USGS) W71-04569

CARBON DIOXIDE IN THE PACIFIC OCEAN AND BERING SEA: UPWELLING AND MIX-

Alaska Univ., College. Inst. of Marine Science. J. J. Kelley, and D. W. Hood.

Journal of Geophysical Research, Vol 76, No 3, p 745-752, January 20, 1971. 8 p, 5 fig, 17 ref. ONR Contracts NR 307-252, Nonr 477 (24) and N0014-67-A-0317-0001.

Descriptors: *Water chemistry, *Sea water, *Carbon dioxide, *Saturation, *Mixing, Currents (Water), Ocean currents, Ocean circulation, Airwater interfaces.

Identifiers: Oceanic upwelling.

Measurements of the equilibrium concentration of carbon dioxide with respect to air in the surface waters of the North Pacific Ocean and Bering Sea made on a summer 1968 cruise aboard the R. V. Oceanographer were compared with earlier data collected in the southeastern Pacific Ocean off Peru and Chile. Experimental procedure used infrared analysis of equilibrated air and sea water for CO2. Supersaturation of carbonate in the sea with respect to air was noted within northeastern Pacific coastal regions associated with dilution by river inflow and upwelling. Similarly, data obtained off the South American coast showed high surface-water concentrations of CO2 in areas of upwelling. Undersaturation was observed in the northeast Pacific Ocean near Unimak Pass and east of ST. Matthew's Island in the Bering Sea. Near-equilibrium conditions were observed between 48 deg and 49 deg N latitude and from 161 deg to 150 deg 30 min W longitude. (Knapp-USGS) W71-04570

RELATIONSHIP BETWEEN SALINITY AND CHLORINITY IN THE BUSSE LAGOON, SAK-HALIN,

Akademiya Nauk SSSR, Novosibirsk. Institut Geologii i Geofiziki.

For primary bibliographic entry see Field 02L. W71-04583

VERTICAL ZONING IN CHEMICAL COMPOSI-TION OF GROUNDWATER IN MASSIFS OF EASTERN MONGOLIA AND SOUTHEASTERN TRANSBAIKAL, Akademiya Nauk SSSR, Moscow. Research Lab. of

Foreign Geology. B. N. Marinov, and N. A. Marinov.

Translated from Doklady Akademii Nauk SSSR, 1969, Vol 188, No 2, p 434-437, September-October. Academy Sciences USSR Doklady, Earth Science Sections, Vol 188, No 1-6, p 187-190, April 1970. 4 p, 2 tab, 6 ref.

Descriptors: *Water chemistry, *Groundwater, *Hydrogeology, Aqueous solutions, Salinity, Bicarbonates, Calcium, Magnesium, Sulfates, Ground-water movement, Water balance, Water circulation, Leaching, Aquifers, Mineralogy.
Identifiers: *USSR.

Mountainous massifs are widespread in eastern Mongolia and in the adjacent part of southeastern Transbaikal and often constitute long, low ranges. Structurally, they are generally horsts. They consist of metasedimentary, carbonate and extrusive formations of the Precambrian and Paleozoic; terrigenous and sedimentary volcanic formations of the Triassic and Jurassic; and intrusive complexes, ranging in age from Precambrian to middle Mesozoic, inclusively. The groundwater accumulated in these rocks as a result of the irregular distribution of fractures is free in some places but under pressure in others. It is recharged by atmospheric precipitation and condensed moisture. In the distribution and chemical composition of such water there is vertical zoning. The highest parts of massifs hold extremely fresh, calcium or magnesium bicarbonate water with a salinity of 1 g/liter and with a relatively high concentration of silicon dioxide and organic matter. Downslope, owing to the lengthening of seepage routes and to the longer contact of the water with the host rock. the salinity increases gradually, culminating (at 0.4 to 0.8 g/liter) at the foot of mountain slopes. The water varies in composition as well as in salinity; it changes into sulfate-bicarbonate water or water of mixed anionic and cationic composition. (Knapp-USGS) W71-04584

AQUATIC CHEMISTRY - AN INTRODUCTION EMPHASIZING CHEMICAL EQUILIBRIA IN NATURAL WATERS,

Harvard Univ., Cambridge, Mass. Dept. of Chemistry; and California Inst. of Tech., Pasadena. Dept. of Engineering.

Werner Stumm, and James J. Morgan. New York, NY, Wiley-Interscience, Div of John Wiley and Sons, Inc, 1970. 583 p.

Descriptors: *Water chemistry, *Water resources, *Surface waters, *Groundwater, *Natural resources, Equilibrium, Chemical reactions, Water quality, Chemical properties, Streams, Lakes, Oceans, Soils, Estuaries, Aquifers, Thermodynam-ics, Pressure, Water properties, Physiocochemical properties, Aqueous solution, Hydrolysis, Ionization, Solubility, Chemical analysis, Oxidation, Reduction (Chemical), Surface tension, Adsorp-

Identifiers: *Natural waters, Chemical equilibria.

The aims of this book include the formulation of an adequate theoretical basis for the chemical behavior of ocean waters, estuaries, rivers, lakes, groundwaters, and soil water systems, and the description of the processes involved in water treatment. Comparison of the real systems with idealized counterparts or models is made. These simplified and manageable models clearly illustrate the principal regulatory factors that control the chemical composition of natural waters, and in turn, the composition of the atmosphere. Special attention is given to the chemical processes affecting the distribution and circulation of chemical substances, and, the application of elementary principles of physical chemistry in isolating and identifying some of the variables which affect the composition of the water. (Woodard-USGS)
W71-04589

2L. Estuaries

SURF-BEAT ORIGIN FOR PULSATING BOT-TOM CURRENTS IN THE RIO BALSAS SUB-MARINE CANYON, MEXICO, Geological Survey, Menlo Park, Calif.

For primary bibliographic entry see Field 02J. W71-04352

Field 02-WATER CYCLE

Group 2L—Estuaries

COASTAL LANDFORMS: CRESCENTIC AND RHYTHMIC, Virginia Univ., Charlottesville.

For primary bibliographic entry see Field 02J. W71-04354

METHOD FOR DETERMINATION OF REAC-TION RATES OF CARBON DIOXIDE WITH WATER AND HYDROXYL ION IN SEAWATER, Texas A and M Univ., College Station. Dept. of Oceanography; and Alaska Univ., College. Inst. of

Ronald F. Miller, David C. Berkshire, John J. Kelley, and Donald W. Hood.

Environmental Science and Technology, Vol 5, No 2, p 127-133, February 1971. 7 p, 3 fig, 2 tab, 18 ref. ONR Contract Nonr 2119 (04); NSF Contract

Descriptors: *Water chemistry, *Sea water, *Hydrogen ion concentration, *Carbon dioxide, Kinetics, Aqueous solutions, Equilibrium, Instrumentation, Water analysis. Identifiers: Sea water chemistry.

The kinetics of pH change in solutions containing carbon dioxide and in contract with a gas phase were studied by determining the rate of pH change in a vigorously highlad sample of artificial in a vigorously bubbled sample of artificial sea water. Variations in the effective constants with temperature and chlorinity are given, and the results are related to the values for the second dissociation constant of carbonic acid in seawater. The rate constants suggest that the role of the hydroxyl ion reaction is more important at the ordi-nary pH of the sea than had previously been thought (Knapp-USGS) W71-04359

ON THE CHARACTERISTICS OF FLOODS IN AN ESTUARY, Tokyo Inst. of Tech. (Japan)

For primary bibliographic entry see Field 04A. W71-04409

THE MACROBENTHOS OF THE PAMLICO

RIVER ESTUARY, NORTH CAROLINA, North Carolina Water Resources Research Inst., Raleigh; and North Carolina State Univ., Raleigh.
Dept. of Zoology. Kenneth R. Tenore.

Available from NTIS as PB-197 591, \$3.00 in Available from N118 as PB-197 391, \$3.00 in paper copy, \$0.95 in microfiche. North Carolina Water Resources Research Institute Report No 40, (PhD Thesis), Sept 1, 1970. 113 p, 12 tab, 15 fig, 71 ref, append. OWRR Project B-004-NC (8).

Descriptors: *Benthos, *Estuaries, *Estuarine environment, *Environmental effects, *Water pollution effects, *North Carolina, Plankton, Salinity, Temperature, Dissolved oxygen, Sediments.
Identifiers: *Pamlico River Estuary (NC), Anoxic conditions.

A study of the macrobenthos and its environment in the Pamlico River estuary, North Carolina, included measurements of salinity, temperature, and dissolved oxygen, as well as the particle size and organic matter concentrations of the sediments. alinity ranged from 1 to 20 o/oo, and temperature from 5 to 31C. Anoxic conditions in the bottom water overlying the deeper portions of t estuary occurred in the late summer. Two distinct sediment types were found: a sand substrate in the shallow area, and a silty clay substrate in the deep area of the estuary. The macrobenthos had both low diversity and low density because of harsh environmental conditions of salinity and sediment composition.

The absence of benthic life in much of the deeper portions of the estuary correlated directly with anoxic conditions in these areas. On the basis of trellis diagrams, the estuary was divided into three areas: (1) an oligohaline zone dominated by Rangia cuneata and Nereis succinea, (2) a mesohaline zone with a Macoma balthica-Heteromastus filiformis-Nereis succinea association, and (3) a polyhaline zone at the mouth of the estuary characterized by a Macoma phenax-Mulinia lateralis-Glycera dibranchiata association. Vast seasonal changes appeared in species composition, range of distribution, density, and community delimitation caused by the new set of planktonic larvae in the estuary. A total of 36 species was found during the 1968-1969 sampling program. Except for such species as Rangia cuneata and Nereis succinea, most of the benthos underwent great fluctuations due to recruitment from new set. The macrobenthos undergo significant seasonal cycles in the estuary. This report also includes conclusions and recommendations concerning pollution, dredging, and a proposed highway-hurricane-dam complex across the estuary. W71-04540

BIOTURBATION OF SEDIMENTS IN NORTHERN TEMPERATE ESTUARY,

Chicago Univ., Ill. Dept. of the Geophysical Sciences; New Hampshire Univ., Durham. Jackson Estuarine Lab.; and New Hampshire Univ., Durham. Dept. of Earth Sciences.

Judith E. Winston, and Franz E. Anderson.

Marine Geology, Vol 10, No 1, p 39-49, January
1971. 11 p, 2 fig, 3 tab, 7 ref.

Descriptors: *Estuaries, *Bottom sediments, *Benthic fauna, *Sedimentation, *Sedimentary structures, Sediments, Mud, Sands, New structures. Hampshire.

Identifiers: *Bioturbation, Polychaetes.

The amount of bioturbation decreases up the Great Bay estuary as salinities become lower and the bottom-dwelling fauna change in composition. Species of the polychaete genus Nereis appear to be the most important turbation agents. Four different levels of bioturbation were observed, ranging from highly turbate in a sandy bottom marine environment near the mouth of the estuary, to non-turbate in a silty bottom brackish water environment near the head of the estuary. (Knapp-USGS) W71-04561

COMMON STRATIGRAPHIC BOUNDARIES ASSOCIATED WITH COASTAL AOUIFERS.

Maryland Geological Survey, Baltimore. For primary bibliographic entry see Field 02F. W71-04577

RELATIONSHIP BETWEEN SALINITY AND CHLORINITY IN THE BUSSE LAGOON, SAK-

Akademiya Nauk SSSR, Novosibirsk. Institut Geologii i Geofiziki. L. A. Nepeina, and A. V. Fursenko.

L. A. Nepeina, and A. V. Fursenko. Translated from Doklady Akademii Nauk SSSR, 1969, Vol 188, No 5, p 1111-1112, September-Oc-tober. Academy Sciences USSR Doklady, Earth Science Sections, Vol 188, No 1-6, p 213-214, April 1970. 2 p, 2 tab, 3 ref.

Descriptors: *Salinity, *Lagoons, *Bays, Evaporation, Mixing, Streamflow, Water balance, Regression analysis, Water analysis.
Identifiers: *USSR, *Sakhalin.

The water of the Busse Lagoon, Sakhalin, USSR, which is connected with Aniva Bay by a narrow strait and also receives much fresh water from streams and creeks, shows no specific persistent relationship between the components of the salt. Surface and bottom samples were taken at 10 stations. The stations were planned to cover all the more and less fresh-water diluted parts of the lagoon and points most representative of the salinity distribution. The salinity and chlorinity of the Busse Lagoon water were fitted into a relationship by the method of least squares. In the chlorinity range of 16.0 to 17.5 percent, the relationship is for Busse Lagoon water: S (in percent) — -1.6979 plus 1.9079 Cl (in percent). (Knapp-USGS) W71-04583

TEMPERATURE AND WATER-QUALITY CONDITIONS OF THE PATUXENT RIVER ESTUARY, MARYLAND, JANUARY 1966 THROUGH

DECEMBER 1967, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 05C. W71-04585

DISSOLVED FATTY ACIDS IN THE JAMES RIVER ESTUARY, VIRGINIA, AND ADJACENT OCEAN WATERS.

Virginia Inst. of Marine Science, Gloucester Point. For primary bibliographic entry see Field 05A. W71-04586

BIOGEOCHEMISTRY OF TRACE ELEMENTS IN A COASTAL PLAIN ESTUARY: DISTRIBU-TION OF MANGANESE, IRON, AND ZINC IN SEDIMENTS, WATER, AND POLYCHAETOUS WORMS.

Bureau of Commercial Fisheries, Beaufort, N.C. Center for Estuarine and Menhaden Research. For primary bibliographic entry see Field 05A. W71-04587

SABELLARIA REEF MASSES IN DELAWARE

Delaware Univ., Newark. Dept. of Biological Sciences; and Delaware Univ., Newark. Marine Lab.

Harry W. Wells.

Chesapeake Science, Vol 11, No 4, p 258-260, December 1970. 3 p, 3 fig, 6 ref.

Descriptors: *Reefs, *Estuaries, *Delaware, *Annelids, Sedimentation, Sedimentary structures, Tides

Identifiers: *Delaware Bay, *Polychaetes, *Sabellaria reefs.

Along the western shore of Delaware Bay the polychaetous annelid Sabellaria vulgaris builds reefs which are formed of sand grains cemented together in rounded masses of dwelling tubes. They occur principally near the low tide line on sandy beaches in the lower part of the bay, where higher salinity waters, turbulence from wave action, a supply of sand, and a firm or hard substrate occur together. These reefs have important geological and biological effects on the immediate environ-ment, modifying and stabilizing beach sediments, and supporting a distinct community of associated organisms. (Knapp-USGS) W71-04588

AQUATIC CHEMISTRY - AN INTRODUCTION EMPHASIZING CHEMICAL EQUILIBRIA IN

NATURAL WATERS,
Harvard Univ., Cambridge, Mass. Dept. of Chemistry; and California Inst. of Tech., Pasadena. Dept. of Engineering

For primary bibliographic entry see Field 02K. W71-04589

TRITIUM STUDY OF THE MIXING OF WATERS IN LAKES AND ESTUARIES, WITH PARTICULAR REFERENCE TO THE LAKE OF GENEVA AND THE GIRONDE (FRENCH).

Paris Univ., Thonon-les-Bains (France). Center for Geodynamic Research.

For primary bibliographic entry see Field 02H. W71-04594

SALINITY AND WATER CIRCULATION IN THE VELLAR ESTUARY.

Southampton Univ. (England). Dept. of Oceanography; and Marine Biological Station, Porto Novo (India).

(India). K. R. Dyer, and K. Ramamoorthy. Limnology and Oceanography, Vol 14, No 1, p 4-15, January 1969. 12 p, 12 fig, 2 tab, 9 ref.

Descriptors: *Estuaries, *Water circulation, *Saline water-freshwater interface, Mixing, Tides,

Saline Water Conversion—Group 3A

River flow, Stratified flow, Chemical stratification. Currents (Water), Temperature, Salt balance. Identifiers: India, Vellar estuary, Bay of Bengal, Salinity gradient.

An account is given of the results of a 1967 study of the Vellar estuary South India, which discharges into the Bay of Bengal. More than 2,200 measurements each were made of salinity, temperature, and speed and direction of water currents. This typical bar-built estuary is shown, by comparison dimensionless stratification parameters, to be a salt-water wedge at high rates of river discharge. At decreased rates of river discharge the estuary becomes well-stratified with the net flow reversing at depth and both advection and diffusion contributing importantly to the upstream salt flux. During the tidal cycle, the salt wedge near the bottom becomes isolated in a series of basins during ebb tide. The water circulation at high river discharge rates is dominated by a meander system of alternating scour holes, with the high seaward flow in the deepest areas. Superimposed on this is a secondary lateral circulation system that breaks down and reverses direction at low river flows when the saline water inflow develops. (Lang-USGS) W71-04607

MOLYBDENUM IN SOME OCEAN AND ESTUARINE WATERS, Southampton Univ. (England). Dept. of Oceanog-

raphy.
P. C. Head, and J. D. Burton.
Journal Marine Biological Association of the
United Kingdom, Vol 50, No 2, p 439-448, 1970. 2 fig, 4 tab, 21 ref.

Descriptors: *Molybdenum, *Oceans, *Estuaries, Atlantic Ocean, Rivers, Seasonal, Sampling, Salini-

Identifiers: English Channel (England), Southampton Water (England).

Molybdenum in samples of sea water from the English Channel and from different depths at five stations in the Northeast Atlantic was determined. The average concentrations, 11.5 and 10.9 micorgrams molybdenum per liter, respectively, for these groups of samples are similar to those reported for most other ocean waters and results confirm previous findings that molybdenum is a relatively uniformly distributed element in sea water showing only minor and irregular variation with position and depth. Measurements of molybdenum in the Southampton Water estuary were made over a 16-month period. Results show that distribution of the element was dominantly controlled by the extent of dilution with river water having a molybdenum concentration (about 0.3 micrograms/liter), a negligible amount compared with sea water. The average ratio of molybdenum to salinity was 0.346 which is similar to that for water of the English Channel. The ratio was reduced in spring, probably by biological activity, but the amount by which it was reduced was less than 1/5th of the winter level. It appears that the amount of molybdenum in sea water will considerably exceed biological requirements in most natural situations. (Jones-Wisconsin) W71-04621

FORCED PLUME IN A STRATIFIED FLUID,

National Center for Atmospheric Research, Boulder, Colo.

G. Douglas Fox.

Journal of Geophysical Research, Vol 75, No 33, p 6818-6835, Nov 20, 1970. 12 fig, 1 tab, 22 ref.

Descriptors: *Buoyancy, *Stratified fluid, *Flow profiles, *Froude number, Plumes, Eddy viscocity,

Identifiers: *Reynolds stress term, *Entrainment, Ambient fluid, Boussinesq equation, Molecular

The model of a forced plume developed is intended to clarify and improve existing plume theories.

Both the classical theories are developed, as is this one, from the assumption that a plume is a fully developed, steady-state phenomenon independent of the source conditions. The Morton model requires the external specification of entrainment. The Priestly and Ball model does not necessarily neglect the continuity equation, and the external specification of entrainment can be achieved in a less arbitrary manner. A turbulent buoyant yet operating in a linearly stratified fluid is investigated. The rate of entrainment of ambient fluid into the plume is found to be an explicit function of the dependent variables such as the Reynolds stress, the form of the similarity profiles and the local mean densimetric Froude number. The Reynolds stress term is shown to be related to the constant obtained if the entrainment rate is assumed to be proportional to the mean center line velocity. A critical parameter of the analysis is the ratio of the form of the velocity profile to the form of the density difference profile. Values of this parameter near unity seem most appropriate. Numerical solutions are composed with experimental results to suggest values for the Reynolds stress term. (Herrera-Vanderbilt) W71-04721

THE UTILITY OF SYSTEMS ANALYSIS IN ESTUARINE WATER QUALITY MANAGE-

MENT, Manhattan Coll., Bronx, N.Y. Dept. of Civil En-

gineering.
For primary bibliographic entry see Field 06A.
W71-04765

03. WATER SUPPLY **AUGMENTATION** AND CONSERVATION

3A. Saline Water Conversion

DEVELOPMENT OF DESALINATION MEM-BRANES,

General Aniline and Film Corp., Easton, Pa. Central Research Lab.

Herman S. Schultz, and Nathan D. Field.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price \$1.00. Office of Saline Water Research and Development Progress Report No 609, December 1970. 109 p, 11 fig, 13 tab, 26 ref. OSW Contract 14-01-0001-1807.

Descriptors: *Reverse osmosis, *Membranes, *Synthesis, Desalination, Membrane processes, Osmosis, Waste water treatment, Water purification. Identifiers: *Copolymers, *Homopolymers, Polyvinyl pyrrolidone, Methyl vinyl ether, Maleic anhydride, Crosslinked films, Diisocyanates.

This report summarizes work on the preparation and evaluation of new reverse osmosis membranes with the objective of finding new polymer reverse osmosis membranes useful for desalinating of brackish and sea water, and/or purification of acid mine and other polluted waters. It was hoped that materials would be found that have a combination of properties superior to those based on cellulose acetate. Water flux, salt rejection, mechanical strength, % water absorption and salt distribution coefficient measurements were used to evaluate the results. Almost all the films studied were of the dense type and the primary focus was on salt rejection rather than water flux. It was felt that materials that showed good salt rejection could be studied subsequently to improve water flux. More specifically, the program consisted of the fabrication of water insoluble membranes based on homo and copolymers of vinyl pyrrolidone and/or vinyl ethers using several broad approaches to be described. Most of the polymers utilized were materials now manufactured commercially by GAF, experimental materials, or reaction products of such materials. Water content and salt distribution coefficient measurements on water-equilibrated films were

determined in a number of cases as an aid in evaluating materials. The use of Bierbrich Scarlet dye was found to be a valuable tool for diagnostic purposes beyond the detection of pinholes. (Horowitz-Office of Saline Water) W71-04426

EFFECT OF POROUS BACKING SUBSTRATES ON MEMBRANE FLUX IN REVERSE OSMOSIS SYSTEMS,

Hydronautics, Inc., Laurel, Md. Gedeon Dagan, and Arye Gollan.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Price \$0.35. Office of Saline Water Research and Development Progress Report No 614, December 1970. 21 p, 8 fig, 10 ref. OSW Con-

Descriptors: *Desalination, *Reverse osmosis, *Permeability, *Porosity, Membranes, Membrane processes, Osmosis.

Identifiers: *Porous supports, *Composite membranes, Pressure drop, Water flux, Salt rejection, Flux decline.

The effect of porous substrate characteristics on the overall performance of a composite reverse osmosis membrane assembly is investigated for the two most representative concepts, classified as the parallel and radial flow pattern systems. Pressure drop, as well as flux decline curves, as functions of physical parameters of the system are presented. The overall performance of a reverse osmosis membrane depends not only upon its transport properties, but also upon the specific physical system in which it is situated. It is the object of this presentation to briefly summarize the coupled effect of the pressure drop in the membrane substrate for the parallel flow case and introduce the study of two radial flow systems. It is believed that these three basic flow patterns exist in most commonly used systems and may serve as first approximations for many other similar assemblies. (Horowitz-Office of Saline Water) W71-04427

CHARACTERIZATION OF CELLULOSE ACETATE BUTYRATE MEMBRANES, Universal Water Corp., Del Mar, Calif. S. Manjikian, and M. I. Foley.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Price \$1.00. Office of Saline Water Research and Development Progress, Report No 612, December 1970. 110 p, 15 tab, 31 fig. OSW Contract 14-30-2517.

Descriptors: *Reverse osmosis, *Permselective membranes, *Membranes, Membrane processes, Separation techniques, Saline water, Pressure, *Desalination, Osmosis.
Identifiers: Cellulose acetate butyrate, Cellulosics,

Casting solutions, Flux, Salt rejection.

Three major areas of interest were investigated in this program. These included the characterization of cellulose acetate butyrate membranes, the optimization of cellulose acetate butyrate membranes, the optimization of butyrate membrane performance and the production of tubular butyrate membranes. In addition, work was initiated on CA-CAB bi-membranes and noncellulosic polymers as membrane materials. Exploratory formulations were prepared and tested to evaluate the effect of certain variations in casting solution compositions on membrane performance. These formulations were directed at increasing flux and compaction resistance for butyrate membranes as well as the development of casting solutions which would be suitable for the production of tubular butyrate membranes. Additives to the standard formulation such as glyoxal, have resulted in 50 to 100 percent improvement in membrane flux with an acceptable reduction in membrane selectivity. In addition, membranes of a wide range of properties were prepared from identical casting mixtures by

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varying fabrication conditions, specifically, with diethanolamine as an additive. (Kindley-Office of Saline Water) W71-04428

SURVEY OF THE ION EXCHANGE PROCESS FOR DESALINATION APPLICATIONS.

Control Systems Research, Inc., Arlington, Va.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Price \$1.75. Office of Saline Water Research and Development Progress Report No 616, November 1970. 222 p, 11 tab, 37 fig, 52 ref, 6 append. OSW Contract 14-01-0001-2275.

Descriptors: *Desalination, *Ion exchange, Demineralization, *Resins, Costs, Reviews, Desalination processes, Separation techniques, Waste water treatment, Water supply, Municipal

Identifiers: Moving bed systems, Fixed bed systems, Continuous process systems.

The potential for application of ion-exchange resins to the partial demineralization of brackish water is surveyed. The study documents the results of a literature search of systems which have been investigated, systems currently in use and systems under development for the ion-exchange demineralization of impure water. The ionexchange resin and equipment manufacturing industries were surveyed to obtain up-to-date information on the availability and capability of ionexchange resins and systems applications. On the basis of this information the most economically attractive fixed-bed and continuous process systems were chosen, and subjected to cost modelling and sensitivity analysis for a range of municipal water supply rates (0.1, 1.0 and 10.0 MGD) based on a selected range of inland brackish feedwater salinities (1500 to 3000 ppm total dissolved solids). Parameters for design considerations are given, together with basic economic assumptions. The study also considers resin variations, regenerent types and physical plant layout. The appendices contain a glossary, conversion tables and a complete bibliography of ion-exchange references. (Miller-Office of Saline Water) W71-04429

AN EVALUATION OF DIFFUSION MEM-BRANES FOR WASTE WATER REHABILITA-TION,

Dorr-Oliver, Inc., Stamford, Conn. For primary bibliographic entry see Field 05D. W71-04512

DESALINATION OF IRRIGATION RETURN

WATERS, Federal Water Quality Administration, Fresno,

Calif. San Joaquin Project.
For primary bibliographic entry see Field 05D.
W71-04552

REVERSE OSMOSIS RENOVATION OF MUNICIPAL WASTE WATER.

Aerojet-General Corporation, El Monte, Calif. Environmental Systems Div.

For primary bibliographic entry see Field 05D. W71-04669

APPLICATION OF HYPERFILTRATION TO TREATMENT OF MUNICIPAL SEWAGE EF-FLUENTS,

Oak Ridge National Lab., Tenn. Water Research Program.

For primary bibliographic entry see Field 05D. W71-04671

OPTIMIZATION OF AN ELECTRODIALYSIS

McDonnell Douglas Astronautics Co., Newport Beach, Calif. Water Technology Dept.

For primary bibliographic entry see Field 08C. W71-04767

3B. Water Yield Improvement

THE FOREST AS A STOREHOUSE OF CITY WATER, (IN GERMAN),

Vienna (Austria) Herbert Tomiczek

Allgemeine Forstzeitung, Vol 81, No 5, p 138-139, 1970. 1 fig, 9 ref.

Descriptors: *Water quality control, *Forests, *Water conservation, Subsurface waters, Runoff, Evaporation control, Filtration. Identifiers: Vienna (Austria).

Epidemics of cholera and typhoid fever, and other difficulties related to the supply of drinking water experienced by the people of Vienna during the last 100 years are reviewed. The daily per capita use of water in that city increased from 80 liters in 1873 to 416 liters in 1967. The latter rate of consumption demands extraordinary measures among which an important part is attributed to rational forest management. This is particularly true of the regions providing the supply of subterranean water. Forest stands, kept in optimum condition and proper stocking, reduce the loss of water by evaporation and runoff, and serve as natural filters retaining microorganisms. The water conserving role of the forest is appreciably augmented by an enrichment of coniferous stands with broadleaved species. (Wilde-Wisconsin) W71-04535

HYDROGEOLOGICAL POSSIBILITIES FOR MORE EFFICIENT INTERCEPTION OF GROUNDWATER IN KARST,

Institute for Geological and Geophysical Research, Belgrade (Yugoslavia).

M. Komatina.

Trans. from Vesnik Zavoda Za Geoloska i Geofizicka Istrazivanja, Ser B, No 8, p 83-121. Bulletin of Engineering Geology and Hydrogeology, Ser B, No 8, p 75-110, 1968. 36 p, 14 fig, 3 map, 1 tab, 18 ref.

Descriptors: *Water resources development, *Karst, Water wells, Dams, Reservoirs, Hydrogeology, Grouting, Groundwater movement, Water yield, Discharge (Water), Water balance, Aquifers, Water management (Applied), Water sources

Identifiers: Horizontal interception galleries, Yu-

Karst hydrogeology and water development in Yugoslavia are reviewed. Karst terrains have a high hydroelectric potential because of the favorable hypsometric relationships between the water-bearing horizons and the abundant precipitation on their catchment areas. However they are unfavorable from the point of view of making them watertight. In Yugoslavia deep-level sealing is often used, by setting up a grouting apron. In the last 10 years or so comprehensive hydrogeological explorations have been carried out in a number of localities in the Yugoslav karst with the aim of intercepting groundwater for water supplies. Interception is the best way to solve the water supply problems of arid karst regions. While exploratory boreholes are not an efficient method of prospecting, horizontal in-terception galleries always lead to the development of exploitable quantities of flowing water. Boreholes are particularly unfavorable for exploitation in the littoral karst because they more easily upset the equilibrium between salt and freshwater on pumping. In order to make more efficient use of groundwater in karst, its regime must be artificially regulated. (Knapp-USGS) W71-04612

INVESTIGATION OF STORM PRECIPITATION PATTERNS OF THE LOS ANGELES RIVER AND SAN GABRIEL RIVER DRAINAGE

BASINS AND THE SHIFTS IN THE NATURAL PRECIPITATION PATTERN PRODUCED BY ARTIFICIAL NUCLEATION.

North American Weather Consultants, Goleta,

Prepared for Los Angeles County Flood Control District, NMWC Report No 15-2, June, 1961. 99 p, 49 fig, 7 tab, 12 ref.

Descriptors: *Cloud seeding, *Cloud physics, *Storm structure, *Artificial precipitation, *Weather patterns, Chemistry of precipitation, Water resources, Hydrologic cycle, Storm runoff, Precipitable water, Rainfall intensity, Probable maximum precipitation, Rainfall disposition, California California.

Identifiers: *Los Angeles County, San Gabriel Mountains.

New information on cloud physics and precipita-tion mechanisms was applied to the clarification of natural rainfall distribution and to the identification of expected cloud seeding effects in the Los Angeles and San Gabriel River watersheds under various types of storm conditions. In particular, it was desired to ascertain why and how some storms produce heavy intensities of precipitation in the mountains relative to the valleys and other storms produce the reverse distribution, a matter of considerable concern in the management of flood control facilities. There was developed in the study, through mathematical analysis, detailed models of air-flow over a mountain barrier and the fall of precipitation particles from clouds onto the mountain surface under a variety of meteorological conditions. Within the general framework of the models, formulae were developed in which various air mass properties, obtained from rawinsonde observations taken several hours upwind at Long Beach Airport and Santa Monica, were related to the difference between mountain area precipitation rates and those in the upwind valleys. It was concluded that: (1) the employment of the theoretical storm models as a general guide, and the statistical regression method as the quantitative assessment device, was a rewarding procedure; (2) A PRE-DICTION METHOD FOR MAKING HIGHLY ACCURATE SHORT TERM QUANTITATIVE PRECIPITATION FORECASTS HAS BEEN DEVELOPED ON HISTORICAL DATA; AND (3) the precipitation prediction method can be adapted to the evaluation of cloud seeding effects. (Poertner)

3D. Conservation in Domestic and **Municipal Use**

MODEL FOR CAPACITY EXPANSION PLANNING OF WATER DISTRIBUTION NET-

Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics; and Massachusetts Univ., Amherst Dept. of Civil Engineering. For primary bibliographic entry see Field 06A. W71-04351

3F. Conservation in Agriculture

IMPACT OF IRRIGATION DEVELOPMENT ON INCOME AND TRADE, EASTERN AND CENTRAL SOUTH DAKOTA.

South Dakota State Univ., Brookings. Dept. of **Economics**

Thormod Christensen, and Arthur J. Matson. South Dakota Agricultural Experiment Station, Bulletin 550, February 1969. 51 p, 8 fig, 57 tab, 33 ref. OWRR Project A-001-SDAK (6).

Descriptors: *Economic impact, *South Dakota, *Irrigation programs, *Water management (Applied), *Cost-benefit analysis, Resource allocation, Planning, Economic prediction, Evaluation, In-

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come, Water conservation, Water allocation (Policy), Crop production, River basins, Employment ney), Crop production, River basins, Employment opportunities, Water supply, Stability, Labor, Credit, Limiting factors, Education, Industries. Identifiers: *Trade, Trade areas, Resource areas, Political districts, Business, Sales receipts, Special

This study investigated the significance of resources allocated to irrigation with attention to retail and service industries. Such a study allows water-management choices consistent with objectives. Peoples are represented in trade areas, resource areas, river basins, and political districts. Personal-income increment from adoption of feasi-ble irrigation in eastern and central South Dakota was estimated to be \$55.6 million. Total state gain would be \$126 million. Over \$111 million would accrue to trade-area residents, with \$15 million spilling over to other areas. Increased trade volume would create new opportunities for business and employment. The major effect of increased irrigation is improvement in sales receipts and personal income for resident firms and persons. Reliable irrigation supply, labor, technical level, and crop requirements are factors in development. Credit agencies are closely involved with irrigation implementation. Irrigation development requires educational facilities and special services. Limitations of the study and suggested future investigations are evaluated. Figures and tables present economic-im-pact data on irrigation development. (Popkin-Arizona) W71-04421

MOLECULAR STRUCTURE AND HERBICIDAL ACTIVITY OF SOME SUBSTITUTED UREAS.

Department of Agriculture, Saint-Jean (Quebec). Research Station.

E. J. Hogue. Weed Science, Vol 18, No 5, p 580-582, 1970. 3 fig, 13 ref.

Descriptors: *Molecular structure, *Herbicides, *Ureas, Toxicity, Halogenated pesticides, Adsorption, Translocation, Monuron.

Identifiers: *Substituted ureas, Coriantrum sativum L, Lycopersicum esculentum Mill, Diuron, Linuron, Monolinuron, Metobromuron, Chlorbromu-

The effect was determined of slight differences in molecular structure on the relative toxicities of the substituted urea herbicides. In preemergence application of six different substituted urea herbicides on coriander (Coriandrum sativum L) and tomato (Lycopersicum esculentum Mill), monohalogenated compounds were more effective in the destruction of plants than their dihalogenated counterparts. The relative difference in effectiveness was much greater in the resistant coriander which appears to take up less dihalogenated than monohalogenated herbicide. The dihalogenated herbicides were generally slightly more toxic than their monohalogenated counterparts in postemergence application. It appears that selectivity could be due to two factors: differential absorption and/or translocation and differential metabolism. The fact that tomato is equally susceptible to all six herbicides in preemergence and postemergence applications may indicate, first, that this plant has no metabolic defense against this group of compounds and secondly, that it absorbs and translocates them equally readily to leaves where they are destructive. Coriander appears to absorb and translocate the monohalogenated substituted ureas; the dihalogenated compounds appear to be either not as easily absorbed by roots or less readily translocated from root tissue. (Jones-Wisconsin) W71-04534

PAPERS REGARDING COLLECTED AGRICULTURAL WASTE NITRATES IN WATERS.

Federal Water Quality Administration, San Fran-For primary bibliographic entry see Field 05B.

W71-04546

IRRIGABLE ACREAGE IN NEW MEXICO AND PROJECTED DEMANDS FOR IRRIGATION

New Mexico State Univ., University Park. Dept. of Agricultural Economics and Agricultural Business. Marlin L. Hanson.

Available from NTIS as PB-197 660, \$3.00 in paper copy, \$0.95 in microfiche. Completion Report, Nov. 1970. 10 p, 3 tab, 3 ref. OWRR Project B-008-NMEX (1).

Descriptors: *Irrigation efficiency, Economics, Regression analysis, Statistical models, Costs, Economic feasibility, *New Mexico.

The land area of nine counties in New Mexico was classified according to its economic potential for irrigated crop production. Crop enterprise budgets were developed for production alternatives on 65 soils in the nine counties. Net returns for representative crop combinations were regressed on four soils and two climatic variables to obtain a predictive equation that was used to rate and classify all soils within the nine counties in four irrigable and two nonirrigable classes. Additional analysis is made possible by use of the predictive equations as soil surveys of the remaining counties become available. (Holmes-Rutgers) W71-04674

04. WATER OUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

GROUNDWATER MEASUREMENTS AT THE SITE OF THE SYLVENSTEIN DAM IN THE BAVARIAN ALPS.

Gesellschaft fuer Strahlenforschung m.b.H., Mu-(West Germany). Institut Radiohydrometrie.

For primary bibliographic entry see Field 02F. W71-04385

THE RELATIONSHIP BETWEEN LAG TIME AND THE PHYSICAL CHARACTERISTICS OF DRAINAGE BASINS IN SOUTHERN ONTARIO, Queen's Univ., Kingston (Ontario).
For primary bibliographic entry see Field 02E.

THE INFLUENCE OF RESERVOIR STORAGE ON STATISTICAL PEAK FLOWS,

Institut fuer Wasserwirtschaft, Berlin (East Ger-

D. Lauterbach, and A. Leder.
In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 821-826, 1969. 6 p, 1 fig, 2 tab, 4 ref.

Descriptors: *Peak discharge, *Reservoir storage, *Flood control, Statistical methods, Regulation, Frequency analysis, Reservoir operation, Water management (Applied). Identifiers: Germany (GDR).

The average influence of reservoirs on peak flows at different recurrence intervals is shown. For some examples the effect of regulation is ascertained and related to the reservoir area percentage. By means of this relation-valid for similar basin characteristics--it is possible to estimate the effect of regulation on natural flood conditions after completion of dams. (Knapp-USGS) W71-04395

ROUTINE ESTIMATION OF SOIL

MOISTURE DEFICITS, British Meteorological Office, Bracknell (En-

For primary bibliographic entry see Field 02G. W71-04396

DETERMINATION OF STORM RUNOFF BY THE USE OF INFILTRATION INDEX,

Ministry of Railways, Lucknow (India). For primary bibliographic entry see Field 02A.

INTERRELATION OF RIVER WATER AND UNDERGROUND WATER DURING FLOOD PERIODS.

State Hydrological Inst., Leningrad (USSR); and Moscow State Univ. (USSR).

For primary bibliographic entry see Field 02A. W71-04398

REFORESTATION EFFECTS ON WINTER AND SPRING FLOOD PEAKS IN CENTRAL NEW YORK STATE,

Geological Survey, Washington, D.C. W. J. Schneider. In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publica-tion No 85 (Unesco-WMO), p 780-787, 1969. 8 p,

Descriptors: *Peak discharge, *Vegetation effects, *Small watersheds, *New York, Vegetation regrowth, Rainfall-runoff relationships, Overland flow, Infiltration, Floods, Runoff, Forest management, Watershed management, Water yield, Statistical methods. Correlation analysis. Identifiers: Experimental watersheds

Reforestation of 58% of a small watershed in Central New York reduced winter and spring flood peaks by amounts ranging from 66% in November to 16% in April. Although average reductions of 30% for March and 16% for April are indicated, about one out of seven peaks during these two months is now higher than before the reforestation. The reduction occurred during the 25-year period following reforestation as the 1,250,000 trees planted in 1931 and 1932 grew toward maturity. Since 1958, when crown cover was estimated at 90%, there has been no significant change in the flood peaks. This indicates that the effect of the reforestation on the flood peaks has stabilized and can be expected to remain constant unless the forests are significantly altered. (Knapp-USGS) W71-04400

STORM RUNOFF FROM **FORESTED** CATCHMENTS BY SUBSURFACE ROUTES,

Forest Service (USDA), Columbus, Northeastern Forest Experiment Station. R. Z. Whipkey

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 773-779, 1969. 7 p, 2 fig, 14 ref.

Descriptors: *Subsurface runoff, *Overland flow, *Floods, *Peak discharge, *Base flow, Ground-water movement, Hydraulic conductivity, Turbulent flow, Hydraulics, Soil water movement, Flood control, Infiltration, Surface-groundwater relation-

Identifiers: Subsurface storm runoff.

Subsurface stormflow and not overland flow is the major source of flood flows from wetted, unfrozen forest soils of the Allegheny-Cumberland plateau of the eastern United States. Studies aimed at detaining flow from the catchment showed a need for more knowledge of subsurface flow mechanics and of the nature of the porous medium. Small plot and watershed studies showed greatest quantities and rates of flow from fine-textured soils and lesser amounts from coarse-textured soils. However,

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hydraulic conductivity of the soil matrix was too low for the flow to be mass interflow. Further tests showed turbulent storm flow occurred primarily from large biological and structural openings in the profile--even when the soil profile was unsaturated. Further study of soil channel hydraulics is proposed. Preliminary plot treatments using contour trenching and backfilling to break soil channel continuity and soil layers have minimized subsurface storm flow from the catchment region above the trench. (Knapp-USGS) W71-04401

INFLUENCE OF SOILS, VEGETATION AND GEOMORPHOLOGY ON ELEMENTS OF THE FLOOD HYDROGRAPH,

Agricultural Research Service, Beltsville, Md. Hydrograph Lab.

H. N. Holtan, and N. R. Creitz.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 755-767, 1969. 13 p, 5 fig, 3 tab, 11 ref.

Descriptors: *Flood forecasting, *Hydrograph analysis, *Routing, *Vegetation effects, *Infiltration, *Water storage, Peak discharge, Discharge (Water), Design flood, Design storm, Flood routing, Geomorphology, Reservoir design, Flood con-

Identifiers: Flood hydrographs.

Infiltration capacity during intermittent rainfall is discussed as a function of storage exhaustion with time. A system is presented for estimating the maximum storage capacity of a given soil and for evaluating vegetation as a modifier of storage availability and its rate of exhaustion. A technique is included for computing infiltration recovery during periods of slight or no rainfall. Techniques are demonstrated for rapid computation of the flood hydrograph, or of peak flows only, through application of a storage constant readily obtainable from previously observed hydrograph recessions. Actual and design storms are compared with observed hydrographs. Suggestions are given for research to provide the parameters necessary for application of both infiltration and flood routing procedures. (Knapp-USGS) W71-04402

FLOOD PLAIN INFLUENCE ON FLOOD WAVE PROPAGATION ALONG A RIVER, State Hydrological Inst., Leningrad (USSR) For primary bibliographic entry see Field 02E.

DESIGN HYDROGRAPHS OF SPRING FLOODS AND METHODS OF THEIR COMPUTATION (BASED ON BYELORUSSIAN RIVER OBSERVATIONS),

Politekhnicheskii Institut. Belorusskii Minsk (USSR); and Ministry of Land Reclamation and Water Economics, Minsk (USSR).

For primary bibliographic entry see Field 02E. W71-04404

W71-04403

COMPUTATION OF DESIGN SPRING FLOOD HYDROGRAPH,

All-Union Designing, Surveying and Scientific Research Inst. Hydroproject, Moscow (USSR). For primary bibliographic entry see Field 08B. W71-04405

SPRING FLOOD HYDROGRAPH COMPUTA-TION ON THE BASIS OF DATA ON INFLOW TO THE WATERSHED SURFACE AND INTO THE RIVER SYSTEM,

Gidrometeorologicheskii Nauchno-Issledovatelskii Tsentr, Moscow (USSR).

V. I. Sapozhnikov.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 715-722, 1969. 8 p, 2 fig, 1 tab, 8 ref.

*Snowmelt. Descriptors: *Flood forecasting, *Snowmelt, *Routing, *Hydrograph analysis, Rainfall-runoff relationships, Climatology, Runoff, Streamflow, Peak discharge, Topography. Identifiers: USSR.

Schemes which make it possible to compute hydrographs of spring floods for a given inflow to the watershed surface and into the river system, form the basis of runoff forecast methods and calculation of maximum discharge probability. The basic parameters and characteristics of calculation diagrams are determined based on observations from a comparatively dense hydrometeorological network. When determining the inflow of snowmelt water to a basin and calculating its flow down a river system along slopes covered with snow, it is necessary to take into account forest areas, water equivalent of snow cover, snow water storage, areal coverage of snow, air temperature, etc. It is necessary to develop new kinds of observation, such as observation of snowmelt intensity, decrease of the area of snow cover during thawing, intensity of water percolation into the soil, etc., to improve methods of estimating runoff progress during spring floods. (Knapp-USGS) W71-04406

THE ESTIMATION OF RUNOFF OF LARGE AND MEDIUM RIVERS PROCEEDING FROM THE RUNOFF OF MINOR RIVERS, State Hydrological Inst., Leningrad (USSR).

M. I. Gourevitch.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 708-715, 1969. 8 p, 4 fig, 1 tab, 2 ref.

*Rainfall-runoff relationships. *Streamflow forecasting, *Routing, Base flow, Infiltration, Seepage, Streamflow, Runoff, Hydrograph analysis.
Identifiers: Isochrone method, USSR.

A runoff-forecasting method using indicator-basins is proposed. The conditions of the indicator-basins specified by introducing the notion of homogeneous runoff regions, the time lag is computed, and the dependence of the discrepancy between the observed runoff and that calculated by the isochrones scheme allows calculation of the inaccuracy of the isochrone scheme and the influence of channels unaccounted for by the isochrone scheme. The proposed method can be widely used because the runoff of large and medium rivers may be computed directly from the ru-

noff of small rivers without using rainfall data and infiltration and evaporation losses. (Knapp-USGS) W71-04407

CALCULATION OF FLOOD DISCHARGES BY MEANS OF THE UNIT HYDROGRAPH,

Nauchno-Issledovatelskii Ukrainskii Gidrometeorologicheskii Institut, Kiev (USSR).
V. I. Mokliak, and T. A. Tchekushkina.
In: Floods and Their Computation, Vol 2, Interna-

tional Association of Scientific Hydrology Publica-tion No 85 (Unesco-WMO), p 700-707, 1969. 8 p, 4 fig, 3 tab.

Descriptors: *Flood forecasting, *Unit hydrographs, *Routing, Hydrograph analysis, Discharge (Water), Peak discharge, Hydrographs, Topography, Snowmelt. Identifiers: Isochrone method, USSR.

The possibility of application of the unit hydrograph to determination of the spring flood discharge is discussed. The hydrograph ordinates are calculated by a specific genetic formula based on construction of isochrones after maximum velocity of water movement in the sections for a given time interval, and on transformation of the discharge in these sections by lag coefficients. A unified UH design allows determination of hydrograph discharges at the outlet at any division of the basin into sections. Whether the process of runoff from all the basin, or the discharge in gaging sections of sub-basins is considered, the hydrographs at the outlet will be the same. The application of the suggested unit hydrograph, as shown by calculated examples, allows solution of the problem of the regulating effect of a reservoir system in the basin on spring flood discharges and determination of the effect of human activity on river flow. (Knapp-USGS) W71-04408

ON THE CHARACTERISTICS OF FLOODS IN AN ESTUARY, Tokyo Inst. of Tech. (Japan).

H. Kikkawa, and H. Shi-igai.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 910-918, 1969. 9 p, 7 fig, 1 tab, 1 ref.

Descriptors: *Estuaries, *Flood control, *Flood forecasting, *Flood routing, *Floodgates, Flood protection, Routing, Tides, Streamflow forecasting, Storm runoff, Computer programs. Identifiers: Japan.

The behavior of floods in an estuary is rather complicated from the hydrological and hydrodynamical points of view. In particular, the high tides caused by typhons and the functioning of control gates are the most important ones to be treated. Where a river is affected by flood and high tides caused by typhoons, the optimum operation of control gates located at the estuary is investigated. The flood routing for a given runoff is also studied for two actual cases by the use of electronic computers. Efforts were made to obtain a stable computing method for high speed and medium speed digital computers with minimum possible computing time, and to obtain a satisfactory method of gate operation to minimize the maximum water level in the channel. (Knapp-USGS) W71-04409

STATISTICAL CORRELATION OF HIMALAYAN AND BUNDELKHAND BASIN CHARACTERISTICS WITH FLOOD FLOWS, Uttar Pradesh Irrigation Research Inst., Roorkee

S. N. Gupta, A. P. Bhattacharya, and S. R. Jindal. In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 874-880, 1969. 7 p, 2 fig, 1 tab, 7 ref.

Descriptors: *Rainfall-runoff relationships. *Streamflow forecasting, *Flood forecasting, *Unit hydrographs, *Statistical methods, Probability, Peak discharge, Frequency analysis. Identifiers: India, Uttar Pradesh, Himalaya, Bun-

The flood flow for a basin is generally evaluated either by: (1) empirical formulas, (2) statistical or probability methods and (3) unit hydrograph method. Each method utilizes one or more elements of basin characteristics but none can be considered of universal applicability for the prediction of flood discharge. An attempt was made to correlate peak flood derived by the unit hydrograph method for eight Himalayan and Bundelkhand catchments in Uttar Pradesh with catchment area, stream length, average stream slope and length from gaging station to the center of the catchment. The statistical derivation can be applied to ungaged catchments for evaluating flood flow. (Knapp-USGS) W71-04411

TRANSFER FUNCTIONS FOR THE ANALYSIS OF RAINFALL-RUNOFF RELATIONS. Technion-Israel Inst. of Tech., Haifa. For primary bibliographic entry see Field 02A. W71-04416

Control of Water on the Surface—Group 4A

DETERMINING SEEPAGE CHARAC-TERISTICS OF MILL-TAILINGS DAMS BY THE FINITEELEMENT METHOD. Bureau of Mines, Spokane, Wash, Mining Research

For primary bibliographic entry see Field 08D. W71-04425

EVALUATION OF THE DECISION PROCESS IN WATER RESOURCES PLANNING,

Stanford Univ., Calif. Dept. of Civil Engineering. For primary bibliographic entry see Field 06A. W71-04516

RESERVOIR OPERATION WITH IMPERFECT FLOW FORECASTS,

British Columbia Univ., Vancouver. Dept. of Civil Engineering.
Samuel O. Russell, and Wilham F. Caselton.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY2, Paper 7931, p 323-331, February 1971. 9 p, 1 fig, 1 tab, 5 ref.

Descriptors: *Reservoir operation, *Streamflow forecasting, *Simulation analysis, Flood control, Multiple-purpose reservoirs, Irrigation water, Water storage, Snowmelt, Water management (Applied), Regulation, River forecasting, Synthetic hydrology.

Identifiers: Okanagan Lake (BC).

Where a large proportion of the runoff originates from snowmelt it is usually possible to forecast inflow to a reservoir with reasonable accuracy. However, in the case of reservoirs which are used for both flood control and conservation there is always some conflict between the flood control requirement for reservation of space and the conservation requirement to store as much water as possible, even though good forecasts can minimize the conflict. Okanagan Lake in British Columbia, Canada, is typical of such multi-purpose reservoirs and each year the dilemma arises as to whether space should be reserved to meet flood control needs or filled to guard against possible droughts. The problem of developing optimal operating policies is examined and a method is presented which uses simulation to assemble available information from the flow forecast, past records of the pattern of flow and the present lake level in a form which illustrates the probable consequences of various courses of action during the forthcoming time period. The operator must still make his own decision but can use the explicity information as a basis for judgment. (Knapp-W71-04576

THEORETICAL PROBABILITY DISTRIBU-TIONS FOR FLOOD PEAKS,

Colorado State Univ., Fort Collins. Dept. of Civil

Engineering. Emir Zelenhasic

Colorado State University Hydrology Paper No 42, November 1970. 35 p, 31 fig, 21 tab, 54 ref, 2 append. NSF Grant GK-11444.

Descriptors: *Stochastic processes, forecasting, *Probability, *Frequency analysis, *Statistical models, Time series analysis, Peak discharge, Hydrograph analysis, methods, Mathematical studies. Statistical Identifiers: Flood peak probability.

Following the theory of the supremum of a random number of random variables, a stochastic model is presented for interpretation, analysis, and predicpresented for interpretation, analysis, and prediction of the largest flood peak discharge above a given base level. The model can be applied to any kind of data of an intermittent process having a substantial stochastic component for which probabilities of the largest value are desired. The model was applied to data from gaging stations on the Susquehanna River at Wilkes-Barre, Pa., and the Greenbrier River at Alderson, W. Va. Results were compared to those obtained by Gumbel's method; they indicate that the introduced model fits the data better. (Knapp-USGS)

W71-04590

RADIOMETRIC METHOD FOR INVESTIGAT-ING THE PERMEABILITY OF RESERVOIR BEDS (RUSSIAN),

Polish Academy of Sciences, Gdansk. Inst. of Hydraulic Research.

E. Makowski.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/45, p 727-741, 1970. 15 p, 12 fig, 3 ref.

Descriptors: *Reservoir leakage, *Canal seepage, *Tracers, *Radioactivity techniques Radioisotopes, Tagging, Tracking techniques techniques. Water loss, Density, Groundwater movement, Soil water movement, Percolation, Seepage. Identifiers: Reservoir leakage tracing

To locate leaks under large areas of a reservoir or canal bed a method was developed based on the use of radioactive solutions and radiometry. The method consists in introducing a homogeneous cloud of radioactive solution having a higher density than the surrounding water above the bottom of the reservoir, on which it settles after a few minutes. In places where there is an increased seepage rate (leakage of water) there is always a slight suction, which draws the radioactive solution out of the cloud on the bottom into the crevices and pores in the ground and thus causes a decrease in the radioactivity of the surrounding medium in the immediate vicinity. Repeated monitoring of the distribution of the radioactivity on the reservoir bottom then permits location of the leaking areas and the determination of their approximate extent. Descriptions are given of the method of injecting the radioactive solution, the equipment employed, and the measurement technique. An example is given of the practical application of the method in a reservoir (at Pszeczica, Poland), where the leaks occurring were causing damage to some parts of the anti-seepage layer and then to the dam itself. Investigations using the method described allowed precise determination of the location and extent of the leaking areas of the bed, showed the hydraulic link between these areas and the corresponding escape of water in the medium surrounding the dam, permitted determination of the leakage in the anti-seepage layer and confirmed that under the clay anti-seepage layer there are areas of considerable infiltration, which were the direct cause of the damage. (Knapp-USGS) W71-04603

NEUTRON INVESTIGATION OF THE RATE OF WATER SEEPAGE FROM IRRIGATION CHAN-NELS AND RESERVOIRS IN LOESSIAL LOAMS (RUSSIAN), All-Union Scientific Research Inst. of Hydrogeolo-

gy and Engineering Geology, Moscow (USSR). A. I. Danilin.

A. I. Danim.
In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/49, p 773-784, 1970. 12 p, 6 fig. 2 tab, 5 ref.

Descriptors: *Nuclear moisture meters, *Soil moisture meters, *Reservoir leakage, *Canal seepage, *Loess, Soil water movement, Groundwater movement, Soil density probes, Gamma rays. Identifiers: *Neutron detectors, Soil density me-

Experimental field studies on moisture conditions in the ground near an irrigation channel, a reservoir, and the area of ground affected were carried out in the USSR in 1968 with neutron moisture gages and gamma-gamma densimeters. Observations of the moisture movement and soil density were made in permanent boreholes up to 16.5 m deep lined with 2 in. steel tubes sealed at the bottom. An all-purpose probe with a high-efficiency slow-neutron detector and a Pu .. Be neutron source, shows a linear dependence between the thermal neutron count and soil moisture. A portable scaler was used as the measuring instrument. The density probe contained a gamma source with an activity of 2 meq of radium. (Knapp-USGS) W71-04604

AMEND THE WATERSHED PROTECTION AND FLOOD PREVENTION ACT.

For primary bibliographic entry see Field 06E. W71-04641

WATERSHED PROJECTS.

For primary bibliographic entry see Field 06E. W71-04642

AQUATIC WEED CONTROL.

Robert Blackburn, and Ralph Scott.

Southern Water Resources Conference, 14th Meeting, Miami Beach, July 31-August 2, 1968. Council of State Governments, Southern Office, Atlanta, n d, p 13-15.

Descriptors: *Aquatic weed control, *Water resources development, *Administration, *Herbicides, Planning, Weed control, Alligatorweed, Cutting management, Aquatic weeds, Aquatic plants, Water hyacinth, Vegetation effects, Riparian plants, Floating plants, Governments, State governments, Local governments, Federal govern-ment, Legislation, Government finance, Mechanical control, Mechanical equipment, Aerial photography, Remote sensing, Surveys.

Outlining state and federal programs for control of undesirable aquatic plants, this speech at the fourteenth meeting of the Southern Water Resources Council notes that, although herbicidal methods may have a detrimental effect on fish and wildlife, they are less harmful than the uncontrolled plants. The new uses of infrared and color photography from aircraft or satellites to survey and locate areas of plant infestation are mentioned, and traditional and modern mechanical plant control methods are discussed. New federal legislation and appropriations are also mentioned. The text concludes that, in place of a project-by-project approach to aquatic weed problems, a comprehensive nationwide control program is needed to permit early detection and control of serious infestation. (Liptak-Florida) W71-04643

SOCIO-ECONOMIC STUDY OF MULTIPLE-USE WATER SUPPLY RESERVOIRS,

Stone (Ralph) and Co., Inc., Los Angeles Calif. For primary bibliographic entry see Field 06B. W71-04672

PROCEEDINGS WORKSHOP ON STREAM CHANNELIZATION WETLAND AND DRAINAGE.

North Carolina Water Resources Research Inst.,

Available from NTIS as PB-197 673, \$3.00 in Available from N115 as PB-197 of 3, \$3.00 in paper copy, \$0.95 in microfiche. Report No. 45, UNC-WRRI-71-45, (1970). 100 p. Edited by David H. Howells. Conference held at Rougemont, N.C. Nov. 18, 1970. OWRR Project A-999-NC

Descriptors: *Stream channel improvement, *Wetlands, *Ecology, *Aquatic ecosystem, *Environ-mental effects, Land reclamation, Freshwater marshes, North Carolina.

Identifiers: *Stream channelization, *Wetland

The objectives of this workshop were to explore the beneficial and adverse effects of stream channelization and wetland drainage in cross-the-table discussion between persons of different points of view, to facilitate more effective project review, and to

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

identify research needs. Participants included representatives of federal and state agencies, North Carolina Wildlife Federation, League of Women Voters and the University of North Carolina system. Proceedings includes summary of work group discussions under the following headings: Objectives of stream channelization and wetland drainage; Alternatives; Beneficial effects; Adverse effects, Documentation of effects; Effectiveness of mitigating measures; Broader planning implica-tions; Public education; and Research and study needs. (Howells-North Carolina) W71-04673

RECREATION AND FISH AND WILDLIFE PROGRAM FOR THE STATE WATER PRO-

California State Dept. of Water Resources, Sacra-

David E. Pelgen, and Floyd P. McFadin.

May be obtained from the Dept. of Water Resources, P.O. Box 388, Sacramento, Calif. 95802. Department of Water Resources Bulletin No 117, December, 1968. 31 p, 3 fig, 1 tab.

Descriptors: *Recreation, *Recreation facilities, *Recreation demand, *Wildlife conservation, *Fish management, *California, *Multiple-purpose projects, Water resources development, Conservation, Fish conservation, Social aspects, Water de-

Identifiers: *California State Water Project.

A proposal is described for implementation of the program of the Department of Water Resources for including recreation and fish and wildlife enhancement features in the State Water Project. The background of the statutory and administrative basis for the program are given, and the present situation is described as well as the Department's schedule for developing recreation and fish and wildlife plans over the next five years within the present framework of the Water Code. The Davis-Dolwig Act of 1961 provided that the development of new recreation sites, along with features that will enhance the State's fish and wildlife resources, be included as a part of the State Water Project. The Act also assigned responsibility for planning such features to the Department of Water Resources. Financing is provided from State Water Project Funds, Tidelands Oil Revenues, and the State General Fund. A number of recreation features have already been constructed at completed Project units. Pertinent sections of the Davis-Dolwig Act are included. The policy of the Resources Agency for carrying out the Davis-Dolwig Program is outlined. (Poertner) W71-04684

SYSTEMS ANALYSIS FOR URBAN WATER

MANAGEMENT, Water Resources Engineers, Inc., Walnut Creek, Calif.

For primary bibliographic entry see Field 06A. W71-04755

PRELIMINARY POLICY MODELS FOR GREAT LAKES REGULATION,

Cornell Univ., Ithaca, N.Y. Dept. of Water Resources Engineering. For primary bibliographic entry see Field 06A. W71-04760

AN INTERINDUSTRY FORECASTING MODEL WITH WATER QUANTITY AND QUALITY

CONSTRAINTS,
West Virginia Univ., Morgantown. Dept. of Economics.

For primary bibliographic entry see Field 06A. W71-04761

APPLICABILITY OF SHORT-MEMORY MODES TO ENGLISH RIVER-FLOW DATA, Birmingham Univ. (England). For primary bibliographic entry see Field 06A.

W71-04770

INTRA-YEAR WATER STORAGE, Arta (Greece).

C. Venetis.

Technometrics, Vol 12, No 4, p 741-749, November 1970. 9 p, 9 ref.

*Stochastic processes. *Water Descriptors: storage, *Seasonal, *River flow, *Monthly, *Markov processes, Reservoirs, Equations, Regulated

The purpose of intra-year water storage was to impose upon the seasonally fluctuating river flows some uniformity in order to secure in a probabilistic sense a certain draft, generally varying with season, during all seasons of the year. Monthly flows of the stochastic structure of equations were considered and the approach was based on Moran's Markov chain concept of the reservoir content fluctuations. For the approximate bivariate Markov chain the seasonal limiting distributions were derived. The distribution of the number of occurrences of emptiness during the critical month in N years of reservoir operation was also examined. This distribution was conditional on the month and state of the reservoir content when the reservoir was assumed to start operating. A simple numerical example was computed in order to illustrate the application of the theory. A two-seasonal model was statistically inferred to represent adequately the stochastic generating process of the seasonal inflows. (Kriss-Cornell) W71-04773

MATHEMATICAL MODEL FOR WATER DIS-TRIBUTION SYSTEMS,

Arya Mehr Industrial Univ., Tehran (Iran). For primary bibliographic entry see Field 08B. W71-04775

SURFACE WATER CONTROL IN NEW JERSEY, PART II: DRAINAGE, FLOOD CONTROL AND RELATED POLICIES IN AN URBAN STATE.

Rutgers-The State Univ., New Brunswick, N.J. Bureau of Government Research.

August 1967. 142 p, 5 append.

Descriptors: *New Jersey, *Surface waters, *Administrative agencies, *Water control, Legislation, State governments, Surface runoff, Repulsion (Legal aspects), Riddance (Legal aspects), Judicial decisions, Legal aspects, Erosion, Storm runoff, Ci-ties, Floodwater, Flood control, Water law, Natural flow doctrine, Drainage, Drainage systems, Drainage districts, Watersheds (Basins), Drainage programs, Urbanization, Water policy.

Part II of a two-part report submitted by the New Jersey Bureau of Government Research, this study on surface water control in New Jersey is divided into two chapters: (1) organizational structure and administration, and (2) substantive programs. The first chapter discusses: (1) considerations in formulating organizational recommendations; (2) state level organization as it involves improvements within the present organizational framework, establishing a new department to administer control of surface water, and a modified interagency mechanism; (3) organization below the state level; (4) county level organization, including county water control agencies and employment of a county hydraulic engineer; (5) regional organization and special agencies, including criteria for using regional agencies, watershed districts, drainage districts, and advisory boards; and (6) overview of the organizational structure. The second chapter examines: (1) functions and powers of the control agency; (2) channel encroachments; (3) maintenance of basic channels; (4) regulating storm drainage facilities and controlling downstream problems; and (5) regulation of use and occupancy of flood plains. (Hart-Florida) W71-04787 DEBATE AND HOUSE PASSAGE OF THE WATER BANK ACT.

For primary bibliographic entry see Field 06E. W71-04791

FLOOD PLAIN INFORMATION OF LOWER SOUTH RIVER, METROPOLITAN ATLANTA, GEORGIA.

Corps of Engineers, Savannah, Ga.

Corps of Engineers Flood Plain Report, May 1970. 38 p, 11 fig, 75 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, *Georgia, Historic flood, Flood forecasting, Regional flood, Design flood, Planning, River basin development.

Identifiers: *South River, Henry County, Newton County, Rockdale County (Georgia).

Flooding along South River in DeKalb, Henry, Newton, and Rockdale Counties, Georgia between Flakes Mill Road and Highway 81 at Snapping Shoals is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. The report contains maps, profiles, cross sections, and other data which indicate extent of flooding that has been experienced and that can occur in the future in the Atlanta area. Records from U.S. Geological Survey stream gag-ing stations, some extending from 1939, are an important basis for summarizing the flood situation. The greatest flood known on South River occurred in December 1919, and another great flood, in Bebruary 1961, caused near record stages. Other large floods occurred in January 1947, November 1948, and March 1942. Duration of flooding is relatively short on all streams in the metropolitan Atlanta area, but the high velocities in conjunction with depths greater than 3 ft (up to 20 ft) are extremely hazardous. (Woodard-USGS) W71-04849

4B. Groundwater Management

ISOTOPE TECHNIQUES APPLIED GROUNDWATER MOVEMENT IN

KONYA PLAIN, State Hydraulic Works, Ankara (Turkey). F. Senturk, S. Bursali, Y. Omay, I. Ertan, and S.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/11, p 153-161, 1970. 9 p, 3 fig, 3 tab, 3 ref.

Descriptors: *Tracers, *Deuterium, *Oxygen, **Groundwater movement, Water rest development, Aquifers, Irrigation water, sources, Water yield, Groundwater Sampling, Recharge, Discharge (Water). Identifiers: *Turkey, *Konya plain (Turkey). resources basins,

As the yields of surface waters in the Konya plain, Turkey decrease noticeably in the summer months the need arises for using groundwater reservoirs for irrigation in the region. The locations of aquifers in the Konya plain were determined by using the stable isotopes oxygen-18 and deuterium. Samples were taken every month at 35 sampling points scattered homogeneously throughout the region. In addition, precipitation samples were collected at three points in the recharge area. The stable isotope values of these samples indicated that two main water bodies with different characteristics existed, one at a shallow and the other at a deeper level, and that they were fed by precipitation of continental type. (Knapp-USGS) W71-04375

MANAGEMENT AND ADMINISTRATION OF GROUNDWATER IN INTERSTATE AND INTERNATIONAL AQUIFERS, PHASE I, Bittinger (M. W.) and Associates, Inc., Fort Collins, Colo.

Groundwater Management—Group 4B

Morton W. Bittinger, and Raphael J. Moses. Available from NTIS as PB-197 592, \$3.00 in paper copy, \$0.95 in microfiche. Final Technical Report, October 1970. 157 p, 5 tab, 14 fig, 48 ref. OWRR Project C-1195 (No 3144) (1).

Descriptors: *Groundwater, *Colorado, *Kansas, *Interstate, *Administration, *Water Management (Applied), *Aquifers, Water table, Irrigation wells. Boundaries (Property), Simulation analysis, Prior appropriation, Legal aspects, Groundwater mining, Water law, Computer models, International waters. Identifiers: *Ogallala formation, Interstate aquifers, International aquifers.

State and national boundaries are traversed by natural surface water and groundwater systems, but the flow of water in such systems is not influenced by these boundaries. Considerable history and experience have developed in the United States over the allocation and management of water in interstate and international streams. However, similar agreements between states or with other countries concerning the development and use of groundwater flowing under a state or international line are practically non-existent. This study was designed to be a first look at the physical and legal problems involved with interstate and international aquifers. Approximately 200 interstate and international aquifer situations were identified by state agency and university personnel responding to a questionnaire. The principal conclusion derived from the questionnaire results and related literature research was that many current and potential interstate and international groundwater problems exist which have received little joint attention by the states concerned. A case study was conducted on the Ogallala formation lying across the Colorado-Kansas state line. The study points out the need for similar management to be imposed on both sides of the state line. Legal aspects were reviewed and discussed and a proposed interstate compact was developed. W71-04541

SALT WATER INTERFACE DURING GROUND-WATER PUMPING, Asian Inst. of Tech., Bangkok (Thailand). Div. of

Asian Inst. of Teens, Daniel Water Science and Engineering. ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY2, Paper 7920, p 223-232, February 1971. 10 p, 4 fig, 1 tab, 8 ref, append.

Descriptors: *Saline water-freshwater interfaces, *Saline water intrusion, *Groundwater movement, Water levels, Porous media, Steady flow, Pumping, Water table, Stratified flow, Water management (Applied), Water resources development, Saline water, Saline water systems. Identifiers: Saline water aquifers.

Fresh water, infiltrated over a salt-water-saturated medium, forms a fresh water zone above the salt water which it displaces. By pumping fresh water from drains spaced at periodic intervals in the fresh water zone, the depth to the saltwater-freshwater interface can be controlled. An analysis relates the equilibrium position of the two fluid interface to the pumping rate, physical properties of the fluids and porous media, the geometry describing the drain location, and the heads of fresh and salt water. An electric analog model was constructed to check the validity of the theoretical analysis. (Knapp-USGS) W71-04571

HYDROGEOCHEMICAL EFFECTS OF INJECT-ING WASTES INTO A LIMESTONE AQUIFER NEAR PENSACOLA, FLORIDA,

Geological Survey, Ocala, Fla. For primary bibliographic entry see Field 05B. W71-04578

USE OF GROUNDWATER IN DEVELOPING THE MEKONG DELTA, REPUBLIC OF VIET NAM.

Earth Science Research Corp., Santa Monica, Calif

Eugene D. Michael.

Groundwater, Vol 9, No 1, p 20-24, January-February 1971. 5 p, 1 fig, 7 ref.

Descriptors: *Conjunctive use, *Surface-groundwater relationships, *Groundwater, *Deltas, *Water resources development, Irrigation, Flood control, Water yield, Water storage, Aquifers, Water wells, Water levels, Saline water intrusion. Artesian wells, Confined water.

Identifiers: *Mekong Delta (Viet Nam), Viet Nam.

The Mekong Delta is underlain by an upper section of recent alluvium, and a lower section of older alluvium. The older alluvium contains a permeable artesian zone called the 100-meter aquifer, which is the most productive groundwater reservoir in Viet Nam. Tested well capacities range from about 145 to 635 gallons per minute (gpm); more efficiently designed wells should produce in the range of 500 to 1,000 gpm from this aquifer. Part of the 100meter aquifer is intruded by sea water. Storage is estimated to be approximately 30 million acre-feet in the lower Delta, where the total dry season irrigation requirement is about 1.2 million acre-feet. The most feasible plan for development of the Mekong Delta may involve the conjunctive use of surface water and groundwater of the 100-meter aquifer, even though induced recharge and a groundwater barrier against sea-water intrusion might be necessary. (Knapp-USGS) W71-04579

RECHARGE CHARACTERISTICS OF WATERCOURSE AQUIFER SYSTEM AT

SPRINGFIELD, OHIO,
Geological Survey, Columbus, Ohio; and Ohio
Dept. of Natural Resources, Columbus. Div. of

Stanley E. Norris, and Herbert B. Eagon, Jr. Groundwater, Vol 9, No 1, p 30-41, January-February 1971. 12 p, 9 fig, 5 ref.

Descriptors: *Induced infiltration, *Conjunctive use, *Water yield, *Surface-groundwater relationuse, water yield, Surface grounds with ships, *Ohio, Water resources development, Municipal water, Recharge, Withdrawal, Water level fluctuations. Observation wells, Monitoring, fluctuations, Observation wells, Aquifers, Water wells, Hydrogeology. Identifiers: *Springfield (Ohio).

An investigation was made of infiltration conditions in the alluvial-filled Mad River valley in the vicinity of the Springfield, Ohio, municipal wells. Most recharge to the 100-foot thick sand and gravel aquifer is from induced infiltration from the Mad River. Local precipitation and natural, down-valley underflow also are important in sustaining the 14 mgd pumping rate. Gaging stations were established at points above and below the well field in the expectation that infiltration losses could be measured directly. Observation-well records covering the 4-year period 1965 through 1968 show that groundwater levels follow an annual cycle, typically rising in the period February through June, when recharge exceeds depletion, and falling during the remainder of the year. The rate of induced stream infiltration is not sufficient to prevent perennial dewatering of the aquifer beneath the streambed. During the 7-month depletion period average infiltration is estimated at 9 mgd and during the 5-month accretion period estimated infiltra-tion is 12 mgd. On the basis of these estimates the infiltration rate for the respective periods is 0.37 and 0.50 mgd per acre, or about 0.35 mgd per acre per foot of depth. (Knapp-USGS) W71-04581

PENETRATION RADIOACTIVE LOGGING FOR THE STUDY OF NON-SATURATED AND SATURATED AREAS (RUSSIAN),

All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).

V. I. Ferronskiy, A. I. Avsyuk, G. I. Grinev, V. I. Demchenko, and B. P. Krovopuskov.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/41, p 673-693, 1970. 21 p, 8 fig. 1 tab, 13 ref.

Descriptors: *Soil density probes, *Radioactive well logging, *Core drilling, Boreholes, Gamma rays, Neutron absorption, Soil moisture meters, Nuclear moisture meters, Sediments, Sedimentology, Soil moisture, Soil water, Geology, Mineralogy, Instrumentation.

Identifiers: *Soil probes (Penetration), Penetration radioactive logging.

A new method of radioactive logging for the study of non-saturated and saturated areas, as well as sea bottoms is based on the insertion of a logging probe to a depth of up to 30 meters. A description is given of the special penetration logging devices used in the field. A combination of radioactive logging and penetration methods provides complete information on the physical and mechanical properties of non-saturated and saturated ground. The characteristics and resolving powers of the gamma, gamma-gamma and neutron-neutron logging methods were investigated. Penetration methods have advantages over radioactive borehole logging methods. No drilling is required, and the results of the determinations made are more accurate. Examples are given of the application of penetration logging methods for the study of various areas in arid and humid regions in connection with irrigation projects. Examples are also given of the study of silts and sandy sediments as well as bottoms covered with silt at the Black Sea coast. Penetration logging data were interpreted for the determination of the lithological composition and the structure of the geological profile, the physical characteristics (volumetric weight and moisture content) of soils, and the spatial distribution of these characteristics in non-saturated and saturated areas. They were also interpreted for the determination of the position of water-bearing strata in the profile and the salt content of the groundwater, and used in wetting tests. (Knapp-USGS) W71-04601

PLANNED UTILIZATION OF GROUNDWATER BASINS: COASTAL PLAIN OF LOS ANGELES COUNTY, California State Dept. of Water Resources, Sacra-

mento.

Kiyoshi Mido.

Department of Water Resources, Bulletin No 104, September 1968. 25 p, 13 fig, 6 tab.

Descriptors: *Groundwater basins, *Conjunctive use, *Surface waters, *Surface-groundwater relationships, *Aquifers, Water costs, Water management, Water transfer, Water demand, Coastal plains, Planning, Urbanization, Municipal water, Water supply, Aqueducts, Colorado River Aqueduct, Los Angeles Aqueduct, California. Identifiers: *Los Angeles County.

Four alternative plans of conjunctive use of ground and surface water resources to meet future water requirements in the service area were analyzed. From this analysis, understanding evolved regarding the economic impact of pumping schedule and pattern, spreading schedule of imported water, and methods of preventing sea-water intrusion. The most significant economic factors are the price of imported water and the proportionate use of imported water and groundwater in storage. The water demand of the Coastal Plain of Los Angeles County is approximately 860,000 acre-feet a year at present and is expected to grow to 1,200,000 acre-feet by 1990. Water supply from various sources which include the Los Angeles Aqueduct, the Colorado River Aqueduct, and soon the State Water Project, will be adequate at least until 1990. One of these sources of supply is the ground water basin in the Coastal Plain. Approximately 35 million acre-feet of fresh water is believed to be in storage at present. (Poertner)

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4B—Groundwater Management

W71-04683

4C. Effects on Water of Man's Non-Water **Activities**

EFFECTS OF A CAUSEWAY ON THE CHEMIS-TRY OF THE BRINE IN GREAT SALT LAKE,

Geological Survey, Salt Lake City, Utah. R. J. Madison.

Available from Utah Geological and Mineralogical Survey, Univ. of Utah, Salt Lake City. 84112-Price \$2.50. Utah Geological and Mineralogical Survey Water-Resources Bulletin 14, September 1970. 52 p, 13 fig, 7 tab, 14 ref, 3 append.

Descriptors: *Great Salt Lake, *Utah, *Water quality, *Bridges, *Environmental effects, Rock foundations, Rock fills, Porous media, Salinity, Brines, Chemical analysis, Water analysis, Dis solved solids, Data collections, Construction, Water chemistry, Evaporation, Water circulation. Identifiers: *Railway causeway (Great Salt Lake), *Water quality changes (Great Salt Lake).

During 1957-59, a permeable rockfill causeway was constructed for trains to cross Great Salt Lake, Utah. The causeway divides the lake into two parts and interrupts the formerly free movement of brine about the lake. The causeway has caused significant changes in the chemistry of the lake, including a dilution of the brine in the south part of the lake and a concentration of the brine in the north part. The net movement of dissolved-solids load through the causeway is dependent upon the relationship between the ratio of water discharges in each direction and the concentration of dissolved solids. Estimates made for the 1969 water year indicated that the ratio of total flow northward to total flow southward was about 11:1 through the culverts and about 3:1 through the causeway fill. Discharge through the culverts accounted for about 45 percent of the total brine moving northward but only about 15 percent of the total brine moving southward. (Woodard-USGS) W71-04369

GEOLOGY ENVIRONMENTAL FOR **PLANNING** IN MONROE COUNTY.

Wayne State Univ., Detroit, Mich. Dept. of Geolo-

gy. Andrew J. Mozola.

Michigan Geological Survey Report of Invesitgation 13, 1970. 34 p, 18 fig, 6 plate, 2 tab, 48 ref, ap-

*Hydrogeology, *Urbanianent, Descriptors: *Michigan, City planning, (Applied), Water resources development, Aquifers, Geology, Water levels, Glacial drift, Waste disposal, Water sources, Water supply, Waste water disposal, Septic tanks. Identifiers: *Monroe County (Mich).

Monroe County, situated in the extreme southeast corner of Michigan, is underlain by Paleozoic rock strata dipping gently northwest. The bedrock stratigraphic sequence consists largely of carbonate rocks with some sandstones and shales. The bedrock surface is almost completely veneered by glacial drift varying in thickness from a few inches to nearly 160 feet. Over most of the county, how-ever, the drift is considerably less than 30 feet. Only a few natural rock exposures occur at widely scattered localities. Throughout most of the counsystem to the country, except principal urban areas, domestic water supplies are obtained primarily from wells completed in bedrock; and wastes are deposed in septic tanks. The groundwater resource, therefore, is particularly vulnerable to contamination.

Knowledge of geologic conditions then becomes a crucial consideration in land-use planning. Accompanying the report is a series of half-inch-to mile county maps depicting bedrock geology, bedrock

topography, drift thickness, glacial geology, and piezometric water level. A small bedrock map of the state and a stratigraphic nomenclature chart are also included. (Knapp-USGS) W71-04370

CHANGE OF RUNOFF DUE TO URBANIZA-TION.

Public Works Research Inst., Tokoyo (Japan). T. Kinosita, and T. Sonda.

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publication No 85 (Unesco-WMO), p 787-796, 1969. 10 p, 9 fig.

Descriptors: *Urbanization, *Cities, *Rainfall-runoff relationships, Gaging stations, Streamflow, Model studies, Mathematical models, Routing, Flood routing, Hydrographs, Hydrograph analysis, Synthetic hydrology, Flood forecasting. Identifiers: Tokyo, Japan.

The Public Works Research Institute (Japan) set up a hydrological network on the Syakuzii river basin in the suburbs of Tokyo to find out changes of runoff due to urbanization. This basin is composed of diluvial deposits, and its area is 48 sq. km. Increase of total flood volume, increase of peak discharge and decrease of travel time are caused by decrease of infiltration area, decrease of roughness ground surface and decrease of inundation area due to urbanization. The basin was divided into subbasins and measured by aerophotographs. Floods in 1966 were computed using a storage-runoff relation which contains formulas of drainage channels and the rate of infiltration area. As the computation agreed well with observation, floods were estimated for the case of complete urbanization. (Knapp-USGS) W71-04399

THE MACROBENTHOS OF THE PAMLICO RIVER ESTUARY, NORTH CAROLINA,

North Carolina Water Resources Research Inst., Raleigh; and North Carolina State Univ., Raleigh. Dept. of Zoology.
For primary bibliographic entry see Field 02L.

W71-04540

WHERE IS URBAN HYDROLOGY PRACTICE TODAY.

Department of Housing and Urban Development, Washington, D.C.

D. Earl Jones, Jr.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY2, Paper 7917, p 257-264, February 1971. 8 p, 15 ref.

Descriptors: *Urbanization, *Rainfall-runoff relationships, *Water management (Applied),
*Drainage systems, *Sewers, Utilities, Planning, Storm runoff, Storm drains, Runoff forecasting, Rational formula, Routing, Reviews. Identifiers: *Urban hydrology.

The evolution of urban street construction and its effects upon urban drainage is reviewed. Rational method development and inconsistencies in its application are summarized. Lack of absolute precipitation data inhibits development of improved runoff prediction methods. Urban drainage areas need dual drainage systems to reduce drainage costs, reduce flood losses, to enhance property values, stabilize neighborhoods, and improve urban life quality. Some basic methods for managing urban runoff also attenuate peak flows. A low maintenance channel is more useful than usual urban channel designs. Direct losses from and expenditures for urban drainage approximate four billion dollars per year. The nation could realize disproportionately great returns from urban hydrology research. (Knapp-USGS) W71-04572 COMPUTER SIMULATION OF URBAN STORM WATER RUNOFF,

Water Resources Engineers, Inc., Walnut Creek, Calif.

Carl W. Chen, and Robert P. Shubinski.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY2, Paper 7924, p 289-301, February 1971. 13 p, 9 fig, 1 tab, 12 ref. FWQA Contract 14-12-501.

Descriptors: *Storm runoff, *Storm drains, *Routing, *Open channel flow, *Simulation analysis, Runoff forecasting, Hydrographs, Overland flow, Rainfall-runoff relationships, Urbanization, Rational formula, Hydrograph analysis. Identifiers: *Urban hydrology.

As part of an overall storm water management program, a model was developed to simulate the runoff phenomena of a drainage basin for any given rainfall pattern. The model represents the basin by an aggregate of idealized subcatchments and gutters. The computer is instructed to make a step-by-step accounting of rainfall, infiltration, detention, overland flow and gutter flow in the calculation of a hydrograph. Three preliminary simulations are made to demonstrate the validity of the method. (Knapp-USGS) W71-04574

HYDROGEOLOGICAL AND ENGINEERING GEOLOGICAL FACTORS IN REGIONAL SPA-TIAL PLANNING,

Institute for Geological and Geophysical Research, Belgrade (Yugoslavia).

S. Lukovic

Trans. from Vesnik Zavoda Za Geoloska i Geofizicka Istrazivanja, Ser B, No 8, p 141-148, 1968. Available from NTIS as TT-68-50062. Bulletin of Engineering Geology and Hydrogeology, Ser B, No 8, p 125-131, 1968. 7 p, 6 ref.

Descriptors: *Hydrogeology, *Urbanization, *Planning, City planning, Area redevelopment, Governments, Programs, River basin development, Water resources development. Identifiers: *Yugoslavia.

Hydrogeological and engineering geological factors in regional spatial planning are reviewed. These factors always must be taken into account in an analysis of these conditions in regional development and urbanization. (Knapp-USGS) W71-04613

4D. Watershed Protection

AMEND THE WATERSHED PROTECTION AND FLOOD PREVENTION ACT.

For primary bibliographic entry see Field 06E. W71-04641

WATERSHED PROJECTS.

For primary bibliographic entry see Field 06E. W71-04642

PROCEEDINGS WORKSHOP ON STREAM CHANNELIZATION AND WETLAND DRAINAGE

North Carolina Water Resources Research Inst.,

For primary bibliographic entry see Field 04A. W71-04673

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

ESTIMATION OF ADSORBABLE SOLUTES IN SEAWATER WITH C-LABELLED PHENOL AND ACTIVATED CARBON,

Woods Hole Oceanographic Institution, Mass.

Ralph F. Vaccaro.

Environmental Science and Technology, Vol 5, No 2, p 134-138, February 1971. 5 p, 3 fig, 4 tab, 20 ref.

Descriptors: *Water chemistry, *Sea water, *Organic matter, *Adsorption, *Phenols, Solutes, Aqueous solutions, Laboratory techniques, Activated carbon, Water analysis, Kinetics. Identifiers: Sea water chemistry.

A C-14 tracer technique is proposed by which the kinetics of short-term uptake of labeled phenol on activated carbon provide a quantitative estimate of the adsorbable material in seawater. The method is calibrated by measuring the amounts of C-14 phenol adsorbed under defined conditions in seawater pretreated with activated carbon to completely remove responsive solutes of natural origin. Kinetics relating phenol adsorption to solute concentration show a saturation-type uptake pattern not unlike that described by the Langmuir equation for an equilibrium situation. For sample analysis, the degree of displacement of the phenol calibration curve is evaluated. Shipboard analyses indicative of the remote Atlantic are compared with simultaneous measurements of total dissolved organic carbon obtained with wet combustion. Since the carbon concentrations measured are similar in magnitude, the bulk of the dissolved organic carbon at locations far removed from shore appears to respond to activated carbon in a manner similar to that of phenol. (Knapp-USGS) W71-04357

CONTINUOUS EXTRACTION OF ORGANIC

MATERIALS FROM WATER,
Geological Survey, Denver, Colo; and Federal
Water Quality Administration, Edison, N.J.
Marvin C. Goldberg, Lewis DeLong, and Lloyd

Environmental Science and Technology, Vol 5, No 2, p 161-162, February 1971. 2 p, 1 fig, 3 ref.

Descriptors: *Solvent extractions, *Analytical techniques, *Water analysis, *Organic matter, *Monitoring, Solutes, Colloids, Separation techniques, Immiscibility, On-site tests, Data col-lections, Water quality, Organic compounds, Solvents.

Identifiers: *Dissolved organic matter sampling.

A continuous liquid solvent extractor, designed to utilize organic solvents that are heavier than water, is described. The extractor is capable of handling input rates up to 2 liters per hour and has a 500-ml. extractant capacity. Extraction efficiency is dependent upon the p-value, the two solvent ratios, rate of flow of the aqueous phase, and rate of reflux of the organic phase. Extractors can be serially coupled to increase extraction efficiency and, when coupled with a lighter-than-water extractor, the system will allow the use of any immiscible solvent. (Knapp-USGS)
W71-04358

MICHIGAN CHEMICAL QUALITY OF

STREAMS, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02K. W71-04362

EFFECTS OF A CAUSEWAY ON THE CHEMIS-TRY OF THE BRINE IN GREAT SALT LAKE. UTAH,

Geological Survey, Salt Lake City, Utah. For primary bibliographic entry see Field 04C. W71-04369

THE IMPACT OF LEAD-ZINC MINING ON THE QUALITY AND ECOLOGY OF SURFACE WATERS IN SOUTHEAST MISSOURI, Missouri Water Resources Research Center, Rolla;

and Missouri Univ., Rolla. Ernst Bolter

Available from NTIS as PB-197 528, \$3.00 in paper copy, \$0.95 in microfiche. Completion Report, Missouri Water Resources Research Center. December 1970. 76 p, 3 tab, 19 fig, 38 ref, 6 append. OWRR B-021-MO (2).

Descriptors: Water pollution, Mining industry, *Heavy metals, Analytical techniques, Geochemistry, Copper, *Spectroscopy, Missouri, *Mine wastes, *Pollutant identification. Identifiers: Lead, Zinc, Viburnum Trend (Mo).

The background concentrations were determined for copper, lead, and zinc in the streams of the Viburnum Trend or New Lead Belt of Southeast Missouri. Analytical methods were developed for atomic absorption spectroscopy. These methods initially consisted of coextraction of copper, lead, and zinc using the APDC/MIBK system, and finally of extraction of copper by APDC/MIBK and direct analysis of lead and zinc using the newly developed 'Sampling Boat' technique. The data obtained from these analyses were arranged in histograms and critically analyzed. The background concentrations were established to be 4-6 ppb for all three elements. Methods are presented for identifying both short term and long term contamination by using the data distributions. Short term contamination of a factor of 2-3 was determined to occur on the Bee Fork below the St. Joseph Lead Company's Fletcher Mine. The data distributions were not useful for geochemical prospecting under the studied geological conditions. It is recommended that future studies be initiated in order to establish the degree of long term contamination introduced by the industrialization of this scenic area. (See also W71-04538) W71-04537

GEOCHEMICAL EFFECTS OF MINING POL-LUTION ON THE STREAMS OF SOUTHEAST

Missouri Univ., Rolla; and Missouri Water Resources Research Center, Rolla. Ernst Bolter, and Nicholas H. Tibbs.

Available from NTIS as PB-197 531, \$3.00 in paper copy, \$0.95 in microfiche. Completion Report, Missouri Water Resources Research Center. OWRR Project A-023-MO (1).

Descriptors: Water pollution, Mining, *Heavy metals, Geochemistry, Streams, Analytical techniques, Missouri, Copper, *Mine wastes, *Pollutant identification. Identifiers: Lead, Zinc, New Lead Belt (Mo).

Streams in the 'New Lead Belt' of SE Missouri were analyzed for copper, lead and zinc. This area, which a few years ago was sparsely settled and not industrialized, is rapidly developing into the largest lead-zinc mining district of the United States. The data of this study were compared to the results of a pre-mining investigation to determine if the mining activity contributed to the pollution of the streams by heavy metals. Data from an individual mine indicate that the milling waste waters can increase the heavy metal content of the receiving stream up to seven times. However, the heavy metal content of the stream decreases to background concentrations within a distance of three miles. The summarized data of the total area do not indicate a noticeable increase of the heavy metal content in the streams. The average concentrations in the streams at the time of the present investigation

were 5.3 ppb for copper, 8.9 ppb for lead and 9.5 ppb for zinc. The calcium content is in the range of 45 ppm. The magnesium content in the range of 1-30 ppm. The pH of the streams ranges from 7.0-8.8. It is concluded that the mining activity presently does not significantly pollute the streams with heavy metals. (See also W71-04537 and W71-W71-04538

DISSOLVED FATTY ACIDS IN THE JAMES RIVER ESTUARY, VIRGINIA, AND ADJACENT OCEAN WATERS,

Virginia Inst. of Marine Science, Gloucester Point. T. B. Stauffer, and W. G. MacIntyre. Chesapeake Science, Vol 11, No 4, p 216-220, December 1970. 5 p, 4 fig, 1 tab, 13 ref.

Descriptors: *Organic acids, *Estuaries, *Sea water, *Lipids, Organic compounds, Sampling, Water analysis, Chromatography, Gas chromatog-

Identifiers: *James River (Va), *Fatty acids.

Waters of the James River estuary and adjacent continental shelf were sampled at 34 locations. Dissolved fatty acids were analyzed by gas-liquid chromatography. Total acids generally ranged from 10-25 micrograms per liter while individual fatty acids ranged from 1-4 micrograms per liter. The C14 and C16 chain lengths were dominant for saturated fatty acids, and C14, C16, and C18 were the most common in unsaturated acids. The proportion of odd-numbered chain-length C15 acid was found to be greater in the estuarine than in shelf water. Differences between fatty-acid concentrations of estuarine and ocean water were not sufficient to serve as distinguishing characteristics for these water masses. (Knapp-USGS) W71-04586

BIOGEOCHEMISTRY OF TRACE ELEMENTS IN A COASTAL PLAIN ESTUARY: DISTRIBUTION OF MANGANESE, IRON, AND ZINC IN SEDIMENTS, WATER, AND POLYCHAETOUS WORMS,

Bureau of Commercial Fisheries, Beaufort, N.C. Center for Estuarine and Menhaden Research. Ford A. Cross, Thomas W. Duke, and James N. Willis.

Chesapeake Science, Vol 11, No 4, p 221-234, December 1970. 14 p, 9 fig, 8 tab, 34 ref. AEC Contract AT (49-7)-5.

Descriptors: *Trace elements, *Estuaries, *North Carolina, *Water chemistry, *Distribution patterns, Water circulation, Geochemistry, Water temperature, Salinity, Tides, Currents (Water), Bottom sediments, Aquatic animals, Annelids. Identifiers: *Newport River Estuary (NC).

The distribution of manganese, iron, and zinc in sediments, water, and in six species of polychaetous worms is described for the Newport River estuary near Beaufort, North Carolina. Concentrations of manganese, iron, and zinc in 0.1 N HCl extracts of sediment samples collected monthly from three stations for 2 years varied with element, location, time, and sediment type. At each station, iron was the most abundant element present in the 0.1 N HCl extracts and zinc was the least abundant. The concentrations of all three elements in the sediments decreased in a seaward direction. The relative order of enrichment of trace metals in sediment when compared with water was zinc, iron, and manganese. The order of enrichment of trace metals in polychaetes relative to sediment and water was zinc, iron, and manganese. (Knapp-USGS) W71-04587

AQUATIC CHEMISTRY - AN INTRODUCTION EMPHASIZING CHEMICAL EQUILIBRIA IN NATURAL WATERS, Harvard Univ., Cambridge, Mass. Dept. of Chemis-

try; and California Inst. of Tech., Pasadena. Dept. of Engineering.

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification of Pollutants

For primary bibliographic entry see Field 02K. W71-04589

MEASURE AN OIL SLICK - AND DISPERSE IT HARMLESSLY.

New Scientist, London, Vol 47, No 716, p 420, August 27, 1970.

Descriptors: *Oil wastes, *Infrared radiation, Solvents, Surfactants, Oily water, Pollutant identifica-tion, *Remote sensing. Identifiers: *Oil slick detection, *Dispersants.

Infrared scanning is being used for accurate plotting of the position and size of oil slicks at sea. Infrared scanner trials over the Santa Barbara Spill demonstrated that oil shows up clearly on the scanner. Considerable progress is also being made in the development of oil dispersants, solvents and surfactants which are harmless to aquatic life. The British Board of trade has authorized the use of several new dispersants at various sites on the coasts of the United Kingdom. (Ensign-PAI) W71-04799

SHELL SPOTS OIL SPOTS.

Chemical Week, 107 (9), p 15, August 26, 1970.

Descriptors: *Oil wastes, *Pollutant identification, *Monitoring, Oily water, Electronic equipment, Instrumentation, Light intensity.

Identifiers: *Oil detection device, Shell Oil Com-

pany, Photocell measurement.

Shell Development scientists at the Emeryville (California) Research Center have come up with a sensitive electronic instrument that can spot minute quantities of hydrocarbon pollutants in water. Tests conducted recently in San Francisco Bay and in southern California near Wilmington. prove the instrument is sensitive enough to detect the presence of six drops of waste oil that was added about 30 feet above the system in a stream moving one ft./second. After detecting the oil, the device sounds an alarm at a remote control station. (Ensign-PAI) W71-04800

SOME TIME AND SPACE RESOLUTION REQUIREMENTS FOR SPACE OCEANOG-

Bureau of Commercial Fisheries, Galveston, Tex.

Robert E. Stevenson.

Advances in Instrumentation Vol 24, Part III. Instrument Society of America. Twenty-fourth Annual Conference Proceedings, Houston, Texas, October 27, 20, 1000 tober 27-30, 1969, p 4. 2 fig, 7 ref.

Descriptors: *Sewage, *Outlets, *Remote sensing, *Aerial photography, Eddies, Pollutant identifica-

Identifiers: Space surveys, Coastal pollution.

Spatial resolution and intervals of repetition necessary for optimum utilization of space-derived, remotely sensed data of ocean surface features were determined from photographs taken from manned space flights. Coastal waters place the greatest demands on this space system. Coastal ed-dies that form sequences of von Karman vortices are some of the ocean surface features that have periods, sizes and enough energy to contribute to local environments. Study of three submarine outlets that carried one billion gallons of sewage to the sea indicated a \$1 million per year advantage if daily data were available on the near shore eddy system. (Ensign-PAI) W71-04801

ANALYTICAL METHODS FOR THE IDENTIFI-CATION OF THE SOURCE OF POLLUTION BY OIL OF THE SEAS, RIVERS AND BEACHES.

Journal of the Institute of Petroleum, Vol 56, No 548, p 107-117, March 1970. 8 fig, 1 ref.

Descriptors: Water pollution sources, *Analytical techniques, Oil, Oil wastes, *Pollutant identification.

Identifiers: *Identification methods, Sample collection procedures, Recovery procedures, *Oil pollution, Coastal pollution.

Methods of identifying sources of oil pollution are presented. Some of the methods have not yet been standardized but have been found satisfactory in oil company laboratories. Method details are given so other laboratories can carry out the analysis. Sample collection procedures, oil recovery procedures and recovery of other extraneous matter in pollutant samples are briefly discussed. (Ensign-PAI) W71-04804

AN APPRAISAL OF SEWAGE POLLUTION ALONG A SECTION OF THE NATAL COAST,

Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Water Research.

D. J. Livingstone.

Journal of Hygiene, Cambridge, Vol 67, No 2, p 209-223, June 1969. 4 fig, 3 tab, 18 ref.

Descriptors: *Sewage, *Indicators, *Bacteria, Pollutant identification, Effluents.
Identifiers: Natal Coast, South Africa, E. coli,

Parasite units, Staphylococci, Salmonellas, Salinity, Coastal pollution.

Distribution and occurrence of coliforms and pathogenic indicators of pollution in near-shore waters along 47 miles of the Natal Coast before submarine outfalls were surveyed. A short run off an Eastern Cape coastal region was included for comparative purposes. The method was based on Escherichia coli I counts, parasite units, staphylococci, salmonellas and salinity. The study will aid in the assessment of future changes in the water quality of the area. (Ensign-PAI) W71-04807

OCCURRENCE OF FALSE-POSITIVE MOST PROBABLE NUMBER TESTS FOR STREPTOCOCCI IN MARINE WATERS,

Connecticut Univ., Storrs. Microbiology Section; and Connecticut Univ., Noank. Marine Research Lab.

John D. Buck.

Applied Microbiology, Vol 18, No 4, p 562-565, October 1969. 1 tab, 17 ref.

Descriptors: *Sewage wastes, Microorganisms, In-

dicators, *Pollutant identification.
Identifiers: *Fecal streptococci, *Most probable number tests, Azide dextrose, Ethyl violet azide.

Applying the most probable number technique with azide dextrose and ethyl violet azide broths for enterococci, the occurrence of false positive test was common in marine and estuarine water samples. Marine bacterium, gram-positive and gramnegative nonmarine bacteria and yeasts were isolated. All cultures demonstrated growth in azide-dextrose, ethyl violet-azide, and K. F. broths. Representative isolates grew in media containing 0.08% NaN3. The value of the most probable number method for fecal streptococci is questionable in assessing domestic waste levels in estuarine waters. (Ensign-PAI) W71-04816

USE OF STABLE ELEMENT DISTRIBUTION PATTERNS FOR PREDICTING DISTRIBUTION RADIONUCLIDES IN MARINE ORGAN-

Puerto Rico Nuclear Center, Mayaguez

Robert Y. Ting. BioScience, Vol 19, No 2, p 1082-1084, December 1969. I fig, 1 tab, 5 ref.

Descriptors: *Radioisotopes, *Distribution patterns, *Aquatic life, *Foods, Analytical techniques, Sampling, Pollutant identification, Path of polluThe use of stable element distribution patterns for predicting the distribution of radionuclides shows that in general food of marine origin contaminated by fallout would provide smaller amounts of radionuclides per unit weight than would foods of terrestrial origin of equal contamination. (Ensign-W71-04818

PULP MILLS TAKE TO THE AIR TO MONI-TOR OCEAN OUTFALLS.

Oregon State Univ., Corvallis.
Fred P. Burgess, and Wesley P. James.
Pulp and Paper, Vol 44, No 10, p 66-68, September 1970. 5 fig, 1 tab.

Descriptors: *Pulp wastes, Waste water disposal, Outlets, *Dispersion, *Aerial photography, Data collections, Data processing, *Monitoring, Remote

Aerial photography offers a possible method for studying dispersion of wastes in the ocean, monitoring waste disposal outfalls from pulp mills and evaluating possible locations for proposed outfalls. By using this method, concentrations throughout the waste plume can be measured in one instant, thus allowing the diffusion analysis to be based on a nonsteady state model rather than the steady state model. This system is safer and quicker than conventional methods. (Ensign-PAI) W71-04825

STUDIES OF POLLUTION IN THE INDIAN RIVER COMPLEX, Florida Inst. of Tech., Melbourne. Univ. Center for

Pollution Research.

T. A. Nevin, and J. A. Lasater.

Florida Academy of Sciences, Quarterly Journal, Gainesville, Florida, Vol 32, No 3, p 225-229, September 1969. 2 tab, 3 ref.

Descriptors: *Pollutant identification, *Chemical analysis, *Marine bacteria, *Nitrates, *Coliforms, Chlorides, Lignins, Phenols, Hydrogen ion concentration.

Identifiers: Estuarine lagoon, Florida Coast.

The Indian River-Banana River Complex is an estuarine lagoon of both economic and aesthetic value. Studies of the nature and levels of pollutants were initiated. Bacteriological evaluations and chemical analysis were carried out in surface waters and bottom samples. Nitrate concentrations and coliform bacteria distributions were studied in detail. Chloride ion distribution, lignin and tannin accumulations and phenol dispersions were investigated. Cuases of the various levels and these pollutants as indicated from the experiment results are discussed. (Ensign-PAI) W71-04830

5B. Sources of Pollution

ADSORPTION OF ISOCIL AND BROMACIL FROM AQUEOUS SOLUTION ONTO SOME MINERAL SURFACES,

Oregon State Univ., Corvallis. Dept. of Agricultural Chemistry, and Oregon State Univ., Corvallis. Environmental Health Sciences Center. Rizwanul Haque, and William R. Coshow.

Environmental Sciences and Technology, Vol 5, No 2, p 139-141, February 1971. 3 p, 2 fig, 2 tab,

Descriptors: *Adsorption, *Herbicides, *Clay minerals, Illite, Montmorillonite, Humic acids, Kaolinite, Silica, Kinetics, Hydrogen bonding, Path of pollutants, Pesticide kinetics. Identifiers: *Uracil herbicides, Isocil, Bomacil.

Adsorption of two uracil herbicides, isocil and bromacil, from aqueous solution on illite, montmorillonite, silica gel, humic acid, and daolinte surfaces was studied. The adsorption can best be represented by Freundich-type isotherms. A humic

Sources of Pollution-Group 5B

acid surface adsorbs considerably more chemical than other surfaces. Montmorillonite and daolinite show a concave-type adsorption, while humic acid exhibits a convex-type. From the adsorption data at two temperatures, the isosteric heats of adsorption as a function of amount of chemical sorbed were calculated. These results suggest a physical-type adsorption for most of the surfaces. At very low surface coverage there is also some hydrogen-bond formation. (Knapp-USGS) W71-04356

SALTY GROUNDWATER IN THE POCATAL-ICO RIVER BASIN, Geological Survey, Morgantown, W.Va.

George L. Bain.
West Virginia Geological and Economic Survey Circular Series, No 11, October 1, 1970. 31 p, 8 fig,

Descriptors: *Saline water intrusion, *Oil fields, *West Virginia, Oil wells, Injection wells, Brines. Saline water, Waste water disposal, Water pollution sources, Path of pollutants, Water quality, Groundwater, Surface waters. Identifiers: *Oil-field brines.

In the Pocatalico River basin of West Virginia, excessive salt concentration in streams and in shallow groundwater has been a problem for some time. The recent use of hydraulic-fracturing techniques to improve the permeability of the area's oilproducing rocks has caused increased drilling. Much salt brine, as much as 80 bbls of brine for one bbl of oil, is generally produced with this oil, creating a brine storage and disposal problem. A number of brine-disposal wells have been drilled for re-injection of the oil-field brines into the 'Injun sand' and the shallower 'Salt sands' (Pottsville Group). Salt brine, oil, or gas are present everywhere in the Salt sands. There is sufficient natural hydraulic head (pressure) on brine in the Salt sands to contaminate overlying fresh-water horizons unless all wells tapping the Salt sands are permanently and properly cased into the Salt sands in this area. (K-napp-USGS)
W71-04368

GEOLOGY FOR **ENVIRONMENTAL** IN MONROE COUNTY, PLANNING MICHIGAN,

Wayne State Univ., Detroit, Mich. Dept. of Geolo-

gy. For primary bibliographic entry see Field 04C.

OF ENVIRONMENTAL CONTRIBUTION TRITIUM MEASUREMENTS TO SOME GEOHYDROLOGICAL

SOUTHERN AFRICA, University of the Witwatersrand, Johannesburg (South Africa); Botswana Geological Survey, Lobatse.

For primary bibliographic entry see Field 02F. W71-04378

MEASUREMENT OF VARIABLE FLOW PAT-TERNS BY A METHOD INVOLVING DILU-TION OF RADIOACTIVE TRACERS (FRENCH), Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

For primary bibliographic entry see Field 08B. W71-04383

THERMAL PROBLEMS: 'OLD HAT' IN BRITAIN,

Central Electricity Generating Board, London (England). F. B. Hawes.

Central Electricity Generating Board Newsletter, No 83, June 1970. 8 p, 2 fig, 4 tab.

Descriptors: *Thermal pollution, *Power plants, Pollution abatement, Foreign design practices,

Cooling towers, Oxygenation, Environmental effects, Temperature.

Identifiers: British power stations, Heat disposal.

Cooling water requirements of modern fossilfuelled plants and of the advanced gas cooled reactors now under construction in Britain are about 120 CFS per 100 MW. Because of the small volumes of water in the rivers in Britain, the electric utilities became interested many years ago in water conservation. Experience gained in Britain could be pertinent to us. The cost of constructing a modern tower-cooled system is considered to be 30 percent more than a direct system of equivalent capacity on the same site. The well-aerated discharge from cooling towers is locally beneficial to a river deficient in oxygen. The reduction in density due to heating is the most important property of heated discharge. The formation of a heated surface layer can be influenced by winds, and special outfall design may be required. A deep intake can prevent the warmed water from recycling. Recently, heat has been injected into physical models to obtain more realistic assessments of the behavior of heated effluents. In theory there is a sound basis that the addition of heat to a river will reduce the solubility of atmospheric oxygen, increase the rate at which oxygen will dissolve into water and increase the rate at which oxygen is used in biological processes. In fact, the oxygen is never decreased between intakes and outfalls of power stations. The occurrence of good angling at the outfalls of many stations suggests that fish can select temperatures they prefer and avoid those they do not. Excessive restrictions can increase electricity costs or result in the inefficient use of natural resources. (Upadhyaya-Vanderbilt) W71-04431

NITRATES IN PLANTS AND WATERS,

Wisconsin Univ., Madison. Dept. of Soil Science. D. R. Keeney

Journal of Milk and Food Technology, Vol 33, No 10, p 425-432, 1970. 1 fig, 7 tab, 54 ref.

Descriptors: *Nitrates, *Plants, *Water, Water pollution sources, Animals, Nitrogen cycle, Fertilizers, Wells, Cropping, Groundwater, Plants, Toxicity, Nitrites, Soils, Mortality, Denitrification, Vegetable crops, Agriculture, Industrial wastes, Organic matter, Ammonification, Nitrification.

Identifiers: Roughage, Methemoglobinemia, Nitrate reductase, Chemo denitrification.

High concentrations of nitrates in waters have been linked to methemoglobinemia in infants, and nitrates in waters and roughage have long been recognized as a cause of animal health deterioration. The problems associated with high concentrations of nitrates in the environment and the forms of nitrogen, transformation of nitrogen in soils and waters, sources of available nitrogen, nitrate movement in soils, and nitrate content of plants are reviewed. Nitrate content of many vegetables appears to be related to factors difficult to control when economically feasible yields are desired. The increase in nitrogen fertilizer usage and waste disposal methods have the greatest impact on nitrate levels in groundwater. The effect of high nitrate concentrations in water, methods to minimize the nitrate content of fresh and processed vegetable products are fields for research as well as investigations to evaluate the effect of high nitrate foods on human beings and on edaphic, genetic, cultural, and processing methods to reduce nitrates in vegetables. (Auen-Wisconsin) W71-04523

RADIOACTIVITY IN CALIFORNIA WATERS

JULY-DECEMBER 1968.
California State Dept. of Public Health, Berkeley. Bureau of Radiological Health.

Radiological Health Data and Reports, p 400-401, 1970. 1 fig, 1 tab, 1 ref.

Descriptors: *Radioactivity, *California, *Water, Analytical techniques, Surface waters, Wells, Streams, Sewage, Industrial wastes, Fallout, Reservoirs, Sampling, Monitoring, Gamma rays, Radium radioisotopes, Strontium radioisotopes, California. Identifiers: Beta radioactivity, Alpha radioactivity.

California's domestic water supplies, mainly of surface origin, contain natural radioactivity in surface streams, radioactivity added by sewage discharge or by industrial waste effluents, and radioactivity from fallout, particularly fallout into open terminal or distribution reservoirs. Gross beta radioactivity in California domestic waters is monitored by California's Bureau of Radiological Health. A few wells, along with some water supplies that use infil-tration galleries, are also sampled. This monitoring is on a continuing basis, since it has not been possible to forecast radioactivity levels in these supplies based upon levels in rain, snow, or surface streams. Monthly 500-ml samples are collected and total solids analyzed for alpha and beta radioactivity. Specific radionuclides are determined semi-annually on composite samples. Gamma-ray emitting nuclides are determined by gamma-ray spectroscopy and radium and radiostrontium by chemical separation and counting. The monthly average beta radioactivity in the suspended-plus-dissolved solids in surface water supplies in California from July through December 1968 are presented. Alpha radioactivity has, usually, been undetectable or very slight. Radioactivity in surface water remains low. No increase has been observed in drinking water due to nuclear device testing during the past several years. (Jones-Wisconsin) W71-04530

THE IMPACT OF LEAD-ZINC MINING ON THE QUALITY AND ECOLOGY OF SURFACE WATERS IN SOUTHEAST MISSOURI,

Missouri Water Resources Research Center, Rolla; and Missouri Univ., Rolla. For primary bibliographic entry see Field 05A. W71-04537

GEOCHEMICAL EFFECTS OF MINING POL-LUTION ON THE STREAMS OF SOUTHEAST

Missouri Univ., Rolla; and Missouri Water Resources Research Center, Rolla. For primary bibliographic entry see Field 05A. W71-04538

PAPERS REGARDING COLLECTED NITRATES IN AGRICULTURAL WASTE

WATERS. Federal Water Quality Administration, San Francisco, Calif.

For sale by Superintendent of Documents, U.S. Government Printing Office, Wash, D.C. 20402, 167.13/4:13030ELY Price \$1.50. Microfiche from NTIS as PB-197 595, \$0.95. Federal Water Quality Administration Water Pollution Control Research Series 13030ELY 12/69, December 1969. 186 p. FWQA Project No 13030ELY.

Descriptors: *Water pollution sources, *Return flow, *Nitrates, *Water pollution control, *California, Drainage engineering, Drainage effects, Irrigainia, Dianiage engineering, Dianiage effects, Irrigation programs, Irrigation systems, Water management (Applied), Eutrophication, Path of pollutants, Groundwater, Irrigation effects, Drainage water, Water quality, Excess water (Soils), Return flow, Drainage programs.
Identifiers: *San Luis Drain (Calif), *San Joaquin

Master Drain (Calif), *Central Valley (Calif).

This is a collection of 11 papers dealing with the closely related topics of (a) concentrations of nitrates occurring in subsurface agricultural waste waters, (b) the source of nitrates, and (c) possible methods for controlling or removing them. The work all deals with subsurface agricultural waste waters of the San Joaquin Valley in California, but much of the information may have general applica-

Group 5B—Sources of Pollution

tion. (See also W71-04547 thru W71-04557) (Knapp-USGS) W71-04546

GENESIS AND SCOPE OF INTERAGENCY COOPERATIVE STUDIES OF CONTROL OF NITRATES IN SUBSURFACE AGRICULTURAL WASTE WATERS,

Bureau of Reclamation, Sacramento, Calif. For primary bibliographic entry see Field 05G. W71-04547

PREDICTING CHANGES IN NITROGENOUS COMPOUNDS IN SOIL-WATER SYSTEMS, Arizona Univ., Tucson.

For primary bibliographic entry see Field 05G. W71-04548

THE MOVEMENT OF NITROGENOUS FERTIL-IZERS THROUGH SOIL COLUMNS,

Bureau of Reclamation, Fresno, Calif. John W. Williford, Thomas C. Tucker, Robert L. Westerman, and Doyle R. Cardon.

In: Collected Papers Regarding Nitrates in Agricultural Waste Waters, Federal Water Quality Administration Water Pollution Control Research Series 13030ELY 12/69, p 29-39, December 1969. 11 p, 1 fig, 9 tab. FWQA Project 13030ELY.

Descriptors: *Leaching, *Nitrates, *Soil water movement, *Fertilizers, *Irrigation effects, Califor-nia, Path of pollutants, Lysimeters, Model studies, Hydraulic models, Drainage programs, Drainage water, Water pollution sources.

Identifiers: *Central Valley (Calif), *Groundwater

To study movement of nitrates in soil systems, 14 lysimeters made of techite (fibre glass) pipe 15 inches in diameter and 6.7 feet in length were filled with four major soil types from the west side of the San Joaquin Valley of California. The volumes extracted from the probes and collected in the leachates were recorded. All of the samples were analyzed for chlorides, ammonia, total nitrogen and atom percent excess N. The nitrate levels in leachates collected during initial leaching and be-fore fertilization ranged from 20,000 ppm in the Oxalis clay to 2,500 ppm in the Panoche fine sandy loam. These high nitrate levels indicate how relatively low levels of native nitrates can be concentrated in the groundwater by leaching. The highest percentage of fertilizer -N was leached from soils to which KNO3 was applied. In Panoche fine sandy loam and Lethent sandy clay loam, respectively, 82 and 65% of the total nitrogen collected in the soil extract was fertilizer-N. By comparison, only 14 to 24% of the N in the extract was fertilizer -N when ammonium sulfate and sulfur-coated urea were the N sources. Much of the added NH4-N is tied up by the clay complex of the soil near the soil surface Since only 30% of sulfur-coated urea was readily soluble and the remainder was treated to dissolve slowly, movement of nitrogen as urea could be expected to be approximately 30% of N movement from KNO3 assuming appreciable hydrolysis did not occur. (See also W71-04546) (Knapp-USGS) W71-04549

AGRICULTURAL NITRATE REDUCTION AT A WATER TABLE,

Agricultural Research Service, Brawley, Calif.

Agricultural Research Service, Brawley, Calif. Southwestern Irrigation Field Station.

L. S. Willardson, and Burl D. Meek.
In: Collected Papers Regarding Nitrates in Agricultural Waste Waters, Federal Water Quality Administration Water Pollution Control Research Series 13030ELY, 12/69, p 41-52, December 1969.
12 p, 6 fig, 2 ref. FWQA Project 13030ELY.

Descriptors: *Leaching, *Nitrates, *Soil water movement, *Fertilizers, *Irrigation effects, California, Path of pollutants, Lysimeters, Model studies. Hydraulic models, Drainage programs, Drainage water, Water pollution sources

Identifiers: *Central Valley (Calif), *Groundwater pollution.

Laboratory studies on large soil columns with a controlled water table and submerged drains show that very low nitrate content water can be delivered from agricultural drains. A field experiment on drain submergence which intercepts groundwater high in native nitrate indicates that denitrified water from irrigated agriculture can reduce nitrate concentrations in drainage water by dilution. Where proper conditions can be established, including oxygen shortage, adequate organic carbon as an energy source, and a bacterial population, anaerobic conditions develop and result in denitrification. Based on the results obtained in the columns, a nitrate-nitrogen content of 500 ppm in the groundwater would require a surface application of 1,000 pounds per acre of nitrogen as a nitrate fertilizer in a single application. (See also W71-04546) (Knapp-USGS) W71-04550

MONITORING NUTRIENTS AND PESTICIDES SUBSURFACE **AGRICULTURAL** DRAINAGE

California State Dept. of Water Resources, Fresno. Quality and Treatment Unit.

L. R. Glandon, Jr., and L. A. Beck

In: Collected Papers Regarding Nitrates in Agricultural Waste Waters, Federal Water Quality Administration Water Pollution Control Research Series 13030 ELY, 12/69, 53-79, December 1969. 27 p, 6 fig, 6 tab, 14 ref. FWQA Project 13030 ELY.

Descriptors: *Leaching, *Nitrates, *Chlorinated hydrocarbon pesticides, *Fertilizers, *Irrigation effects, California, Path of pollutants, Drainage programs, Drainage water, Water pollution sources. Identifiers: *Central Valley (Calif.), *Groundwater

The concentrations of nitrogen, phosphorus, and chlorinated hydrocarbon pesticides were measured in agricultural subsurface drainage from tiled areas of the San Joaquin Valley in California. Average concentrations of nitrogen and phosphorus ranged from 2 to 400 mg/liter and 0.01 to 4.0 mg/liter. Large seasonal variations of tile drainage discharge were observed in all areas and were attributed mainly to irrigation. Tile drainage systems in the northern area discharged the greatest amounts of effluent at 1.8 acre-feet per acre per year. Nitrogen concentrations were the highest in combined drainage from the central area; the average annual concentration was 33 mg/liter; seasonal variation ranged from 22 to 51 mg/liter. Recent and older alluvial soils were higher in nitrogen than basin soils. The quantity of nitrogen in tile drainage seldom correlated with the amounts applied. Chlorinated hydrocarbon pesticide concentrations have decreased in tile drainage from all areas investigated for the last 6 years. Pesticide use records from Kern County showed definite decreases in usage of chlorinated hydrocarbons in favor of organic phosphates. Variations in nitrogen concentrations of tile drainage are more dependent upon the physiographic position and soil series than all other factors. High original nitrate contents of soils account for greater quantities of nitrogen in tile drainage than that contributed by fertilizers. (See also W71-04546) (Knapp-USGS) W71-04551

DESALINATION OF IRRIGATION RETURN

WATERS, Federal Water Quality Administration, Fresno, Calif. San Joaquin Project. For primary bibliographic entry see Field 05D. W71-04552

DENITRIFICATION AGRICULTURAL TILE DRAINAGE,

Federal Water Quality Administration, Fresno, Calif. San Joaquin Project; and Stanford Univ., Calif. Dept. of Environmental Engineering For primary bibliographic entry see Field 05D.

W71-04553

ALGAL NUTRIENT RESPONSES IN AGRICUL-TURAL WASTE WATER,

Federal Water Quality Administration, Fresno, Calif.; and California State Dept. of Water Resources, Fresno.

For primary bibliographic entry see Field 05D.

THE EFFECTS OF NITROGEN REMOVAL ON THE ALGAL GROWTH POTENTIAL OF SAN JOAQUIN VALLEY AGRICULTURAL TILE DRAINAGE EFFLUENTS,

California State Dept. of Water Resources, Fresno; and Federal Water Quality Administration, Alameda, Calif.

For primary bibliographic entry see Field 05D. W71-04555

HARVESTING OF ALGAE GROWN AGRICULTURAL WASTE WATERS, HARVESTING

California State Dept. of Water Resources, Fresno; and Bureau of Reclamation, Fresno, Calif. For primary bibliographic entry see Field 05D. W71-04556

COMBINED NUTRIENT REMOVAL TRANSPORT SYSTEM FOR TILE DRAINAGE FROM THE SAN JOAQUIN VALLEY,

California State Dept. of Water Resources, Fresno; and Federal Water Quality Administration, Fresno, Calif.; and California Univ., Berkeley. Dept. of Sanitary Engineering and Public Health. For primary bibliographic entry see Field 05D. W71-04557

HAZARDS OF MERCURY.

For primary bibliographic entry see Field 05C. W71-04558

NUMERICAL SIMULATION OF DISPERSION IN GROUNDWATER AQUIFERS,

Colorado State Univ., Fort Collins. Dept. of Agricultural Engineering; and Colorado State Univ., Fort Collins. Dept. of Civil Engineering. For primary bibliographic entry see Field 06A. W71-04559

HYDROGEOCHEMICAL EFFECTS OF INJECT-ING WASTES INTO A LIMESTONE AQUIFER NEAR PENSACOLA, FLORIDA,

Geological Survey, Ocala, Fla.

Donald A. Goolsby. Groundwater, Vol 9, No 1, p 13-19, January-February 1971. 7 p, 9 fig, 1 tab, 10 ref.

Descriptors: *Path of pollutants, *Water pollution effects, *Injection wells, *Waste disposal, *Florida, Hydrogeology, Geochemistry, Injection, Aquifers, Groundwater movement, Aquicludes, Confined water, Monitoring, Observation wells.

Identifiers: *Waste disposal wells, *Floridan

aquifer, Pensacola (Fla).

Acidic industrial wastes have been injected into deep wells in a limestone aquifer near Pensacola, Florida, since 1963. Prior geohydrologic studies indicated that the limestone aquifer contained nonpotable water and was overlain by an extensive clay confining layer. Two injection wells are being used to inject the waste at a rate of approximately 2,000 gallons per minute. The injection pressures are about 200 pounds per square inch. Over 3 billion gallons have been injected. Current study indicates that the waste extends outward about 1 mile from the injection wells, and pressure effects extend outward more than 25 miles. Monitor wells show that pressure changes are following a predictable pattern. No wastes have been detected in a monitor well open to the Floridan aquifer immediately above the Bucatunna Clay Member of the Byram Formation and 100 feet from one of the injection wells. In a monitor well open to the receiving formation about 1,300 feet south of the injection wells, effects of the wastes were detected about 10 months after injection began. In early 1968, the pH of the waste was lowered to about 3. Effects of this change were detected at the monitor well about 5 months later. (Knapp-USGS) W71-04578

TEMPERATURE AND WATER-QUALITY CONDITIONS OF THE PATUXENT RIVER ESTUA-RY, MARYLAND, JANUARY 1966 THROUGH

DECEMBER 1967, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 05C. W71-04585

BIOGEOCHEMISTRY OF TRACE ELEMENTS IN A COASTAL PLAIN ESTUARY: DISTRIBU-TION OF MANGANESE, IRON, AND ZINC IN SEDIMENTS, WATER, AND POLYCHAETOUS WORMS.

Bureau of Commercial Fisheries, Beaufort, N.C. Center for Estuarine and Menhaden Research. For primary bibliographic entry see Field 05A. W71-04587

NUCLEAR TECHNIQUES IN STUDIES OF DISPERSION AND SOME OTHER PROPER-TIES OF THE DANUBE, Institut za Nuklearne Nauke Boris Kidric, Belgrade

(Yugoslavia); and Institut za Vodopriv Jaroslav Cerni, Belgrade (Yugoslavia). For primary bibliographic entry see Field 02E. W71-04592 Vodoprivredu

CONTROL OF SPILLAGE OF HAZARDOUS POLLUTING SUBSTANCES,

Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.

For primary bibliographic entry see Field 05G. W71-04615

UNITED STATES V TANKER MONSOON (RECOVERY FOR WRONGFULLY IMPOSED OIL POLLUTION CLEAN-UP COSTS). For primary bibliographic entry see Field 06E. W71-04663

SANTA BARBARA OIL POLLUTION, 1969, A STUDY OF THE BIOLOGICAL EFFECTS OF THE OIL SPILL WHICH OCCURRED AT SANTA BARBARA, CALIFORNIA, IN 1969,

California, Univ., Santa Barbara.
For primary bibliographic entry see Field 05C.
W71-04670

THE ECONOMICS OF CLEAN WATER: ANIMAL WASTES PROFILE.

Federal Water Pollution Control Administration, Washington, D.C.

For sale by Supt. of Documents, U. S. Govt. Printing Office, Washington, D. C. 20402. Price \$1.00. March 1970. Vol 2, 85 p, 18 fig, 10 tab.

Descriptors: *Animal populations, *Farm wastes, *Water pollution sources, *Water pollution control, *Cost analysis, Cattle, Sheep, Poultry, Hogs, Livestock.

Identifiers: *Animal wastes, *Clean wastes, Swine, Milk cows, Stream pollution. Identifiers:

A comprehensive view is provided of the problem of farm-animal wastes in the United States in relationship to pollution of water bodies. A framework is established for estimating costs of animal wastes control to prevent water pollution. In many cases animal wastes have proved to be significant pollution sources that resulted in fish kills and extensive damage to the ecology of the streams. At the present time, however, there is general agreement that not all of the wastes need to be considered as sources of water pollution. Therefore, it would seem that entirely too much emphasis has been placed on the gross possible costs of controlling water pollution from animal wastes. A more realistic base for use in developing programs for water pollution abatement and control from animal wastes is a series of sub-elements that can be independently assessed to determine their pollution potential, applicable control measures, and total pollution control costs. Estimates are presented of the locations, by states, of populations of cattle, milk cows, swine, sheep, and poultry together with discussions of water pollution control practices, wastes discharge frequencies from feedlots, and climate effects. (See also W71-00737, W71-00738, and W71-04686) W71-04685

THE ECONOMICS OF CLEAN WATER: INOR-GANIC CHEMICALS INDUSTRY PROFILE. Federal Water Pollution Control Administration, Washington, D.C.

For sale by Supt. of Documents, U. S. Govt. Printing Office, Washington, D.C. 20402. Price \$3.50. March 1970. Vol 3, 467 p, 64 fig, 65 tab, 86 ref.

Descriptors: *Chemical wastes, *Water pollution sources, *Water pollution treatment, *Waste water treatment, *Pollution abatement, *Inorganic compounds, Chlorine, Fertilizers, Brine disposal, Paints, Inorganic pesticides, Alkalis, Costs. Identifiers: *Inorganic chemical wastes, Chemical

industry wastes, Inorganic wastes.

A description is presented of the inorganic chemical industry, the manpower requirements and costs that the industry would incur in attaining various levels of water pollution abatement over a five year period through 1974. The cost estimates have been based upon published data, general data from contractors on industrial waste treatment methods and costs, and specific data from 59 inorganic chemical plants. The inorganic chemical industry has been defined for purposes of this study as including establishments producing alkalies and chlorine, industrial gases, inorganic pigments, paints and allied products, fertilizers (excluding ammonia and urea), inorganic insecticides and herbicides, explosives, and other major industrial inorganic chemicals. The various production processes, the waste treatment methods practiced, and the possible impact that changes in waste produced are described. Contaminated waste water from the inorganic chemical industry comes primarily from electrolysis and crystallization brines, washings from filter cakes, spent acid and alkalies, and washings from raw materials. (See also W71-00737, W71-00738, and W71-04685) W71-04686

MODELING DIURNAL FLUCTUATIONS IN STREAM TEMPERATURE AND DISSOLVED OXYGEN,

Utah Water Research Lab., Logan.
A. D. Kartchner, N. Dixon, and D. W. Hendricks.
Proceedings of the Industrial Waste Conference,
24th, 1969. Purdue University Engineering Extension Series No 135, Part One, p 436-449. 16 fig, 1 tah 6 ref.

Descriptors: *Water temperature, Dissolved oxygen, Mathematical models, Time series analysis, Temperature.

Identifiers: Little Bear River, Diurnal fluctuation, Fourier Series, Stream temperature.

During the last three years, a project at the Utah Water Research Laboratory has been developing a simulation model for the hydrology and water quality of the Little Bear River, a small mountain valley river system in northern Utah. Two different modeling approaches are inductive empirical mathematical techniques chosen on the basis of their ability to describe the observed data. The two approaches are a Fourier Series curve fitting ap-

proach and a time series index approach. The models account for approximately 90 percent of the total variation in the DO data and about 75 percent in temperature data. The time series index model yields a standard deviation for DO of 0.23 mg/l while the Fourier series model gives a value of 0.25 mg/l. The standard deviation for temperature are 0.67C and 0.66C, respectively. To ascertain the character of seasonal changes in these diurnal fluctuation pattern and 22 data blocks representing different times of the year have been analyzed. The modeling curves were obtained by multiplying the mean value by the diurnal indexes determined from the data. (Upadhyaya-Vanderbilt) W71-04720

FORCED PLUME IN A STRATIFIED FLUID.

National Center for Atmospheric Research, Boulder, Colo.

For primary bibliographic entry see Field 02L. W71-04721

MINIMIZING ABATEMENT COSTS OF WATER POLLUTANTS FROM AGRICULTURE: A PARAMETRIC LINEAR PROGRAMMING APPROACH,

Iowa State Univ., Ames. Dept. of Economics. For primary bibliographic entry see Field 06A. W71-04738

ANALYTICAL METHODS FOR THE IDENTIFI-CATION OF THE SOURCE OF POLLUTION BY OIL OF THE SEAS, RIVERS AND BEACHES. For primary bibliographic entry see Field 05A. W71-04804

LEVELS OF STABLE ZN AND 65ZN IN CRAS-SOSTREA VIRGINICA FROM CAROLINA

Bureau of Commercial Fisheries, Beaufort, N.C. Radiobiological Lab. For primary bibliographic entry see Field 05C. W71-04812

5C. Effects of Pollution

VASCULAR AQUATIC PLANTS IN ACID MINE WATER OF THE MONONGAHELA RIVER, WEST VIRGINIA, West Virginia Univ., Morgantown. Water Research

Roy B. Clarkson, and Jerry A. Moore. Available from NTIS as PB-197 526, \$3.00 in paper copy, \$0.95 in microfiche. 1971. 8 p, 1 tab, 1 fig, 9 ref, Bulletin 2, West Virginia University Bulletin, Series 71, No 7-5. OWRR Project A-005-WVA (3).

Descriptors: *Aquatic plants, *Acid mine water, *Water pollution effects, *Rooted aquatic plants, *Submerged plants, Water pollution, Aquatic weeds, Cattalis, Floating plants, Pondweeds, Plants, Aquatic life, West Virginia, Water quality. Identifiers: *Vascular aquatic plants, Monongahela River basin.

A study of vascular aquatic plants in three West Virginia acid mine water polluted rivers--the Monongahela, Tygart Valley, and West Fork-found plants abundant in many areas. The most common species is Eleocharis acicularis (L.) R. and S. The next most abundant plants are Sagittaria graminea Michx., S. latifolia Willd., Potamogeton epihydrus Raf., P. nodosus Poir., Sparaganium americanum Nutt., and Myriophyllum heterophyllum Michx. Six areas were chosen for intensive study. Water samples from each were analyzed chemically for nitrogen, phosphate, calcium, total acidity, iron and pH. Physical factors studied were the substrate, water velocity, and water-level fluctuation. From a stepwise discriminant analysis, substrate was determined to be the primary physical factor in determining plant distribution. Phosphate

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and water-level fluctuation were also significant. Nitrogen, calcium, total acidity, iron, pH, and water velocity were determined to be nonlimiting for the species studied. (Clarkson-West Virginia) W71-04418

A PRACTICAL APPROACH TO THE ENVIRONMENTAL EFFECTS OF THERMAL DISCHARGES.

Industrial Bio-Test Labs., Northbrook, Ill. Environmental Sciences Div.

Lawrence P. Beer, and Wesley O. Pipes.
Proceedings of the Industrial Waste Conference
24, p 727-744, May 1969. 5 fig, 5 tab, 4 ref.

Descriptors: *Thermal pollution, Temperature, Thermal powerplants, Cooling, Pollution identifi-cation, Cooling water, Lake Michigan, Mississippi cation, Cooling water, Lake Michigan, Mississippi River, Biological properties, Chemical properties, Fish, Water pollution, Water temperature, Plank-ton, Benthos, Nuclear powerplants. Identifiers: Thermal Pollution Surveys.

The technique used in practical surveys on thermal discharges is discussed. The approach consists of: (1) physical measurements, (2) chemical analyses, and (3) biological analyses. This type of survey has been applied to a limited number of locations and those described here are: Lake Michigan, and Mississippi River. Data taken at these sites are summarized. The main conclusions of the paper are: (1) solution to thermal pollution problems will have to be based on evaluation of the particular aquatic environment in question; (2) Field technique of making these evaluations is available and provide a good representation of actual conditions. (3) Continued monitoring of the environment is necessary to determine the relevance of the present water quality standards and to protect in-dustries from unfounded attacks. (Novotny-Vanderbilt) W71-04430

THERMAL PROBLEMS: 'OLD HAT' IN

Central Electricity Generating Board, London (En-

gland). For primary bibliographic entry see Field 05B. W71-04431

DISSOLVED OXYGEN AND TEMPERATURE DATA FOR THE WABASH RIVER FROM CLINTON TO HUTSONVILLE - 1967-68,

Weston Paper and Mfg. Co., Terre Haute, Ind.

A. Elmer Guerri.

Proceedings Industrial Waste Conference 24, p 807-849, May 1969. 15 fig, 26 tab.

Descriptors: *Water pollution, *Thermal pollution, *Temperature, *Dissolved oxygen, Waste assimila-tive capacity, Indiana, Biochemical oxygen de-mand, Photosynthetic oxygen, Waste disposal,

Identifiers: Waste assimilative capacity surveys

The dissolved oxygen and thermal conditions of the Wabash River in the Terre Haute area have been studied. It was observed that there was a definite relationship between river temperature and dissolved oxygen concentration, and that there was little if any relationship between stream flow and dissolved oxygen. It was found that the temperature increased as the water flowed through the stretch of the river under consideration. The survey data indicated that there was practically no deterioration of the river as it passed through the Terre Haute stretch, due to the addition of organic matter that can be biologically decomposed. (Novotny-Vanderbilt) W71-04432

EXPERIMENTAL CAGE CULTURE OF CHAN-NEL CATFISH ICTALURUS PUNCTATUS IN THE HEATED DISCHARGE WATER OF THE MORGAN CREEK STEAM

GENERATING STATION, LAKE COLORADO CITY, TEXAS,

Texas Electric Service Co., Fort Worth. John E. Tilton, and James F. Kelley.

Second Annaul Workshop, World Mariculture Society, Baton Rouge, Louisiana, February 9, 1970. 14 p, 7 fig, 3 tab, 2 ref.

Descriptors: *Temperature effects, Fish, Heat pollution, *Thermal pollution, Thermal power plants, Lakes, Ponds, Temperature, Fish farming, Water pollution effects, Catfishes, *Channel catfish, Tex-

Identifiers: Ictalurus Punctatus, Lake Colorado (Texas).

Beneficial effects are summarized of heated discharges to the fish population of inland reservoirs in Texas. The sample fish were cultured in a discharge canal for three months. A net increase in weight over 400% in a cage of small test fish in 62 days was observed. In the control pond (with no temperature increase) the fish sample showed no increase in weight. The experiment was performed in January 1970. The control fish were fed but they would consume feed only when several days of warm air temperatures increased pond water temperatures. (Novotny-Vanderbilt) W71-04434

TRENDS IN THERMAL POLLUTION CONTROL REQUIREMENTS, Water Pollution Research and Applications, Inc.,

Washington, D.C.

J. I. Bregman.

Cooling Tower Institute semi-annual meeting, Aspen, Colorado, June 22-24, 1970. 13 p.

Descriptors: *Thermal pollution, Water quality standards, Mixing, Temperature, Temperature effects, Fisheries, Fish populations, Rivers, Streams,

There are basically four types of temperature standards in various states. (a) the imposition of the absolute temperature value (maximum temperature), (b) allowable change in the temperature from what it would be without the artificial addition of heat, (c) gradual progression of temperature, (d) mixing some standards. These standards are discussed in regards to fish and fresh water organisms. Some waters exist which are designated to allow no changes from natural conditions. (Waters used as cold water fisheries), in the case of cold water fisheries, most states have established 68F as the maximum allowable temperature and from zero to 5F, with 2F being the usual value, as the maximum allowable increase above background. For warm water fisheries, the maximum allowable temperatures are generally in the range of 83 to 93F and the maximum allowable rise is above 5F. Some special cases of river standards are discussed. (Novotny-Vanderbilt) W71-04435

THERMAL POLLUTION: A SURVEY OF CAUSE AND EFFECT, Midwest Research Inst., Kansas City, Mo.

Michael C. Noland.

Midwest Research Institute, Kansas City, Missouri, MRI paper No 918, Presented at the Bi-Annual Meeting of the Cooling Tower Institute, Houston, Texas, January 20-22, 1969. 21 p, 11 ref.

Descriptors: Thermal pollution, Thermal power plants, Temperature, Temperature effects, Rivers, Reservoirs, Cooling water, Heat, Heat balance, Waste water (Pollution).

The discharge of heated water into streams or reservoirs can have a serious effect on the quality of the water with which it is mixed. Approximately 80% of the water used by industry in the USA is used as cooling water. Sources of heated discharges are discussed in the paper. Heated discharges can affect the quality mainly as (1) the influence on the ability of the water to carry and assimilate waste. and (2) the effect on the biodynamic balance of aquatic life forms. Not all effects of thermal discharges are determined. Possible approaches to the solution of thermal pollution problems are proposed. (Novotny-Vanderbilt)
W71-04439

THE DIET AND INFECTION OF FISHES IN CAVENDISH DOCK, BARROW-IN-FURNESS.

Central Electricity Generating Board, London (England). S. Markowski.

J Zool, Lond, No 150, p 183-197, 1966. 1 fig, 8 tab, 16 ref.

Descriptors: *Thermal pollution, Temperature, Salinity, Fish diets, Infection, Docks, Zooplankton, Ecology, Fish, Trematodes, Worms, Animal parasites, Fish parasites, Fish diseases. Identifiers: Cavendish Dock, Feeding habits.

Some 934 fishes belonging to 10 species were examined in Cavendish Dock, Walney Channel and in the River Dudden in order to study their diet and infection. The water in Cavendish Dock is partially heated by power station cooling water. Changes in salinity affect the specific composition of animal populations and raised temperature promotes the growth of organisms in this water reservoir. The diet and thus the infection of fishes are influenced by these two factors. The salinity of the dock water ranges from 1.3 percent in March to 14.3 percent in August. The temperatures of the water in the unheated part of the dock varied between 7.8C and and in the heated side between 11.2C and 23.5C. As the 300 plankton had practically disappeared, the diet of the dock fishes during this investigation was composed of benthic organisms. This restricted section in feeding apparently does not affect the growth of fishes in Cavendish Dock. Fifteen different species of parasitic worms belonging to Trematoda, Cestoda, Nematoda and Acanthocephala were recorded in fishes examined. In Cavendish Dock only 18 fishes were infected out of 305 examined. The infection of P. flesus in Walney Channel is composed of eight species of parasitic worm. Even during these investigations, signs of change in the animal population was found. (Upadhyaya-Vanderbilt)
W71-04441

EFFECTS OF MARINE SEWAGE DISPOSAL,

Water Pollution Research Lab., Stevenage (En-

gland). For primary bibliographic entry see Field 05E.

POSSIBLE TOXIC EFFECTS OF CYANATES, THIOCYNATES, FERRICYANIDES, FERROCYANIDES AND CHROMATES DISCHARGED TO SURFACE WATER,

Montgomery Research Inc., Pasadena, Calif. R. G. Zehmpfenning.

Proceedings, 22nd Industrial Waste Conference, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 879-883, July 1968. 30 ref.

Descriptors: *Toxicity, Chromium, Aquatic life, Hydrogen ion concentration, Alkalinity, Chlorination, Waste water treatment, Toxins.

Identifiers: *Cyanates, *Thiocyanates, *Ferricyanides, *Ferrocyanides, *Chromates, *Photo-

graphic wastes.

A study was conducted to assess the possible effects of the disposal of treated or untreated photographic process wastes either to flowing surface water or to lagoons overlying impervious formations with respect to public health, beneficial uses of water and aquatic life. The study is concerned not only with the effects of the waste materials as discharged, but also with interactions which may occur between the various components or with the effect of light on development of toxicity. (Ellis-Texas) W71-04501

Effects of Pollution—Group 5C

NITRATES IN PLANTS AND WATERS, Wisconsin Univ., Madison. Dept. of Soil Science. For primary bibliographic entry see Field 05B. W71-04523

IN VIVO ASSIMILATION BY COD MUSCLE AND LIVER TISSUE OF ELEMENTAL **PHOSPHORUS** POLLUTED FROM WATER,

Fisheries Research Board of Canada, Halifax

(Nova Scotia). Halifax Lab.

W. J. Dyer, D. F. Hiltz, R. G. Ackman, J. Hingley, and G. L. Fletcher.

Journal Fisheries Research Board of Canada, Vol 27, No 6, p 1131-1139, 1970. 2 fig, 4 tab, 8 ref.

Descriptors: *Absorption, *Phosphorus, *Water pollution effects, *Sea water, Marine animals, Lipids, Toxicity, Gas chromatography, Temperature, Distribution, Sampling.
Identifiers: *Cod, Muscle, Liver, Elemental

phosphorus.

Elemental phosphorus is known to be toxic to man and other animals and there are demonstrated instances of toxicity of colloidal elemental phosphorus to a freshwater fish species and to a seawater animals. Cod rapidly assimilates elemental phosphorus from sea water into their tissues. In a 16-hour exposure to a concentration of 20-80 ppb, phosphorus was concentrated a 1000-fold in the liver (even more at lower exposure levels), from 10-25 times in white muscle, and about 50-100 times in red muscle. This distribution is roughly in proportion to lipid content and is roughly in proportion to lipid content and is uniform throughout the white muscle of the fillet, thus facilitating sampling. This remarkably rapid uptake of elemental phosphorus by cod has been interpreted as absorption through the gills into the circulatory system. Even low levels of elemental phosphorus must be considered dangerous in a natural environment if fish are exposed for more than a few hours. The very efficient concentration of elemental phosphorus into the liver suggests that analysis of depot fat, organs such as liver of fish would provide the most sensitive indication of possible exposure to elemental phosphorus in seawater environment. (Jones-Wisconsin) W71-04524

CONTRIBUTION TO THE EPIPHYTIC ALGAL FLORA OF THE LAKE NEUSIEDLER, (IN GER-MAN),

Vienna Univ. (Austria). Botanisches Institut und

Botanischer Garten. For primary bibliographic entry see Field 02H. W71-04526

CONTEMPORARY CONCEPT OF THE BIO-SPHERE, (IN RUSSIAN), Akademiya Nauk SSSR, Moscow. V. A. Kovda.

Zhurnal Obschchei Biologii, Vol 30, No 1, p 3-17, 1969. 2 tab, 6 ref.

Descriptors: *Ecosystems, *Aquatic environment, *Balance of nature, Photosynthesis, Organic matter, Food chains, Productivity, Wastes, Phytoplankton, Energy, Radiation, Pesticides, Water pollution sources, Biomass, Proteins,

Microorganisms.
Identifiers: *Hydrosphere, *Biosphere, Food sources, Protein sources, Biogenic matter, Food

potential.

This condensed survey of the animated segments of the earth devotes particular attention to the productive potential of the hydrosphere. Aquatic plants photosynthesize about 45% of the world's total amount of organic matter. The annual production of oceans varies from 36 to as much as 645 gram carbon per square meter. This output is correlated with the quotients of utilizable radiation energy, ranging from 0.02 to 0.33%. The latter maximum efficiency of the hydrosphere coincides with that of forest stands. The present annual production of proteins is about 50% short of the supply required to eliminate the obvious and the concealed starvation of the world's population. There is a hope to supplement the future diet by microorganisms, including those of the hydrosphere. Materialization of this possibility depends on the rigid control of factors disrupting the productive efficiency of aquatic ecosystems, such as promiscuous use of pesticides and discharge of untreated domestic or industrial effluents. (Wilde-Wisconsin) W71-04527

MOLECULAR STRUCTURE AND HERBICIDAL ACTIVITY OF SOME SUBSTITUTED UREAS. Department of Agriculture, Saint-Jean (Quebec). Research Station.

For primary bibliographic entry see Field 03F. W71-04534

THE MACROBENTHOS OF THE PAMLICO RIVER ESTUARY, NORTH CAROLINA,

North Carolina Water Resources Research Inst., Raleigh; and North Carolina State Univ., Raleigh. Dept. of Zoology.
For primary bibliographic entry see Field 02L.

W71-04540

BIOCHEMICAL OXIDATION OF HYDROCAR-BONS IN NATURAL WATERS,

Rhode Island Univ., Kingston. Dept. of Bacteriolo-

For primary bibliographic entry see Field 05D. W71-04543

BIOLOGICAL FIXATION AND TRANSFORMA-TION OF NITROGEN IN SMALL IMPOUND-MENTS,

Oklahoma State Univ., Stillwater. Dept. of Zoolo-

For primary bibliographic entry see Field 02H. W71-04544

HAZARDS OF MERCURY.

Special Report of Study Group on Mercury Hazards to Secretary's Pesticide Advisory Commit-tee, Department of Health, Education and Welfare, November 1970. 97 p, 2 fig, 9 tab, 128 ref, 3 ap-

Descriptors: *Water pollution effects, *Path of pollutants, *Hazards, *Poisons, *Heavy metals, Water quality, Water pollution sources, Public health, Chemical wastes, Organic compounds, Safety, Monitoring, Human pathology. Identifiers: *Mercury, *Methylmercury.

The problem of mercury contamination in the United States is potentially grave. The problem has been under intensive study for some years in Sweden and Finland where the patterns of usage of mercury are similar to those in the United States. The present situation stems from the extensive recent increase in the industrial and agricultural uses of mercury. Methylmercury is concentrated several thousand times in fish and shellfish, partly through contamination of their food and partly through its presence in the water. The relative ease with which methylmercury passes the 'blood-brain barrier' accounts for severe neurologic manifestations. The sources of mercury contamination, which caused a recent poisoning disaster in Minamata Bay and Niigata, Japan, were discharges from plants using mercury catalysts in the manufacture of vinyl chloride and acetaldehyde. Methylmercury was preformed in the effluent of these factories. This report is an assessment of hazards of mercury as of mid-1970. It contains many specific recommendations aimed at better understanding and solution of the mercury problem in the United States. (Knapp-USGS)
W71-04558

HYDROGEOCHEMICAL EFFECTS OF INJECT-ING WASTES INTO A LIMESTONE AQUIFER NEAR PENSACOLA, FLORIDA. Geological Survey, Ocala, Fla.

For primary bibliographic entry see Field 05B. W7 î-04578

TEMPERATURE AND WATER-QUALITY CON-DITIONS OF THE PATUXENT RIVER ESTUARY, MARYLAND, JANUARY 1966 THROUGH DECEMBER 1967, Geological Survey, Washington, D.C.

Robert L. Cory, and Jon W. Nauman. Chesapeake Science, Vol 11, No 4, p 199-209, December 1970. 11 p, 12 fig, 12 ref.

Descriptors: *Remote sensing, *Thermal pollution, *Thermal powerplants, *Estuaries, *Maryland, Water temperature, Heated water, Path of pollutants, Water quality, Water pollution sources, Salinity, Tides, Tidal effects, Water circulation, Salinity, Tides, Tidal effects, Wat Streamflow, Mixing. Identifiers: *Patuxent estuary (Md).

The effect of power plant cooling water in raising natural water temperatures at a location near the power plant on the Patuxent River estuary is clearly evident from thermograph records. Surface temperature at a station 333 m downstream from the discharge canal was raised an average of about 4 C, and at times by as much as 8 C. Temperature rises were greatest during the winter. Infrared imagery showed that elevated surface temperatures could be detected about 5.5 km upstream at flood tide. Temperature profiles obtained from airborne radiation equipment revealed a complicated surface temperature pattern and also showed the effects of density differences and wind action on the steam-electric station effluent plume. Mean annual salinity for a 5-year period (1963-1967) was highest in 1966, about 12.3 parts per thousand, and lowest in 1966, about 12.3 parts per thousand, and lowest in 1967, about 9.9 parts per thousand. Dissolved oxygen values for 1966-1967 ranged from 3.2 to 15.6 mg/liter, and saturation ranged from 55 to 152%. Turbidity levels were inversely related to salinity, with the highest annual mean of 28 Jackson Candle Units occurring in 1967, the lowest salinity year. The extreme tide range was 2.1 m; mean water levels at the Patuxent Bridge were highest in summer and lowest in winter. Water stages are more affected by wind speed and direction than by flow in the river. (Knapp-USGS) W71-04585

EFFECTS OF MINING POLLUTION ON VASCULAR PLANTS IN THE NORTHWEST MIRAMICHI RIVER SYSTEM,

Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station. K. W. Besch, and Patricia Roberts-Pichette.

Canadian Journal of Botany, Vol 48, p 1647-1656, 1970. 5 fig, 3 tab, 15 ref.

Descriptors: *Mining, *Water pollution effects, *Rivers, Copper, Water pollution sources, Submerged plants, Riparian plants, Monocots, Dicots, Toxicity, Invertebrates, Surveys, Flow Hydrogen ion concentration, Grasses

Identifiers: *Northwest Miramichi (Canada), Zinc, Equisetum arvense, Cyperaceae, Cardamine pensylvanica.

Effects of copper-zinc mining pollution on riparian and aquatic vascular plants were studied in the Northwest Miramichi River system of northern New Brunswick. After a period of 8 years, the riparian vascular flora of the river system's gravel shores has been completely eliminated or seriously reduced. The most sensitive plants are the sub-mersed aquatic species, followed by riparian dicotyledons. Monocotyledons are less sensitive than dicotyledons and Equisetum arvense least susceptible species. A rough index of pollution severity was devised based on the absence of species or species groups which would normally be present under unpolluted conditions. The absence of some spring-flowering geophytes normally

Group 5C—Effects of Pollution

present at the high-water line is believed to be caused by the large amounts of toxic metals accompanying the high spring flows. It is possible to distinguish three different degrees of severity of zinc-copper pollution in rivers and streams, according to the effects on the higher vascular flora. With extremely high pollution, trees and shrubs along the banks are killed; with medium to high pollution only a few species are present, mainly Cyperaceae, Cardamineae, and Equisetaceae; dicotyledons are absent. With low pollution only submerged vascu-lar plants are eliminated. (Jones-Wisconsin) W71-04619

CHRONIC MALATHION TOXICITY TO THE MACROCHIRUS (LEPOMIS BLUEFILL

RAFINESQUE), Federal Water Quality Administration, Duluth, Minn. National Water Quality Lab.

John G. Eaton.

Water Research, Vol 4, No 10, p 673-684, 1970. 7 tab, 23 ref. FWQA Program 18050 WAE 12/70.

Descriptors: *Pesticide toxicity, *Organophosphorus pesticide, *Bluegills, *Bioassay, Lethal limit, Life history studies, Spawning, Water pollution effects, Toxicity.

Identifiers: *Chronic toxicity, *Malathion toxicity, *Acute toxicity, Malathion, Flowing-water system,

Acetylcholinesterase inhibition.

An evaluation is made of the usefulness of an application factor in predicting the chronic toxicity of the pesticide malathion. All life cycle stages of bluegills are exposed to several concentrations of malathion (66 to 0.66 microgram/liter) in a diluterregulated, flowing water test system in order to identify safe (3.6 microgram/liter) and unsafe (7.4 microgram/liter) levels. The fish spawned in artificial nests while being held in the test chambers. Egg and fry stages were no more sensitive to malathion than older fish. Brain acetylcholinesterase determinations on fish still alive at the end of the chronic test revealed a reduction in activity of nearly 50% among fish exposed to levels considered unsafe, and a depression in activity of one-third the control in toxicant concentrations considered safe. Acute malathion toxicity is also determined for use in calculation of an application factor (chronic toxicity divided by acute toxicity). The resulting application factor for bluegills agrees very closely with one previously calculated for fathead minnows exposed to malathion, even though the long term toxicity of malathion to bluegills is more than 50 times that to fathead minnows. W71-04666

SANTA BARBARA OIL POLLUTION, 1969, STUDY OF THE BIOLOGICAL EFFECTS OF THE OIL SPILL WHICH OCCURRED AT SANTA BARBARA, CALIFORNIA, IN 1969, California, Univ., Santa Barbara.

A. Foster, M. Neushul, A. C. Charters, and R.

Copy available from GPO Sup Doc as 167.13/4:15080 DZR 11/70, \$0.55; microfiche from NTIS as PB-197 670, \$0.95. Water Pollution Control Research Series 15080 DZR 11/70, October 1970. 49 p, 7 tab, 15 fig, 33 ref. FWPCA Program 15080 DZR.

Descriptors: Water pollution effects, *Water pollution sources, California, *Oily water, Oil wastes, Oil, Littoral, Remote sensing, Aerial photography, *Environmental effects, Intertidal areas, Aquatic habitats, Beaches. Identifiers: *Santa Barbara (Calif), *Oil spillage,

Oil spills, Kelp bed organisms, *Intertidal plants, *Intertidal animals.

The initial flow of oil that began on January 28, 1969, from an offshore oil platform deposited an estimated 4,500 metric tons of pollutant oil on nearly 90 kilometers of coast by February 8, 1969. Winds, wave action, tides, and substrate determined the pattern of the oil distribution in the intertidal zone. Heavy biological damage occurred in

intertidal surf grass and barnacle populations as a result of the oil pollution. Based on earlier surveys, the greatest negative biological change at a sample station was the loss of 16 plant species. However, these losses in species were attributable in most cases to sand movement and other storm-as-sociated events. The potential long-term biological effects of the continuing pollution are discussed. This report consists of the introductory material, two short papers, and general discussions. The first paper, The Santa Barbara Oil Spill, I. Initial Quantities and Distribution of Pollutant Crude Oils, deals with the amounts of stranded oil and its distribution. The second paper, The Santa Barbara Oil Spill, II. Initial Effects on Littoral and Kelp Bed Organisms, deals with the preliminary biological effects that we observed. A treatment of aspects of the Santa Barbara pollution problem that relates the authors observations to those of others, and considers the broader implications of marine pollution in general, has been incorporated in the discussion section. W71-04670

SOCI-ECONOMIC FACTORS RELATED TO THE INCIDENCE OF WATER-BORNE DIS-

Puerto Rico Univ., Mayaguez. Water Resources Research Inst.

For primary bibliographic entry see Field 05F. W71-04675

THE EFFECT OF WATER QUALITY AND EN-VIRONMENTAL FACTORS ON FRESHWATER

New Mexico State Univ., University Park. Dept. of

Biology. W. G. Whitford.

paper copy, \$0.95 in microfiche. Completion Report, (1970). 6 p, 1 ref. OWRR Project A-003-NMEX (1).

Descriptors: *Water quality, Temperature, Hardness, Acclimatization, Hydrogen Ion Concentra-tion, *Fish, Thermal pollution, *Water tempera-

Identifiers: Green Sunfish, Oxygen content, *Thermal Tolerence.

Water temperatures of Rio Grande River ranged from 0C to 29C, pH ranged from 7.4 to 8.6, total hardness varied from 86 ppm in the upper river to 194 .. 6ppm in the reservoirs. The mean critical thermal maximum (CTM) was 39.9C in fish acclimated in fresh water (10-30ppm), 28.2C in fish acclimated in water at 85 ppm, 27.3C in fish acclimated at 171 ppm. Ion concentration of 180 ppm and 25 ppm has no effect on the CTM of the mosquito, fish, Gambusia offinis. The effect of water hardness on upper lethal temperature of the green sunfish Lepomis cyanellus acclimated at 20C and 30C and hardness levels of 30, 180, and 400 ppm indicated no significant effect of hardness on the incipient lethal temperature 35C for 20C acclimation and 40C for 30C acclimation. The relationship between incipient lethal temperature and acclimation is expressed by the equation, Log (LD50) — 1.3220056 (CTM in degree C). Incipient lethal of 31C for 10C acclimated fish was obtained. There was no difference in the critical oxygen tension in active fish and nonactive fish. At acclimation the mean oxygen consumption was 0.177 ml/gm/hr. (Upadhyaya-Vanderbilt) W71-04677

EFFECTS OF WARM WATER DISCHARGES ON SURFACE WATERS (IN GERMAN), Bundesanstalt fuer Gewasserkunde, Coblenz (West

Germany). M. Eckold, H. Knopp, and H. J. Licbsher.

1969.67 p.

Descriptors: *Thermal pollution, Temperature, Fishing, Navigation, Thermal power plants, Nuclear power plants, Cooling water, Self-purifica-

tion, Waste assimulative capacity, Water pollution effects, Physical properties, Biological properties, Heat resistance.

The study deals with the ability of streams or waters to accept and cool the heated discharges from thermal (nuclear) power plants. Such discharges bring about changes in physical and biological conditions of receiving streams. The measures necessary to prevent harmful effects are discussed. The study is aimed at producing basic information for planning and design of future nuclear and thermal power plant locations in Germany. The following are discussed: physical and biological properties and changes under the influence of heated discharges, sewage degradation or self purification, water supply, industrial water supply, navigation, and fishing. (Novotny-Vanderbilt) W71-04718

UTILIZATION OF THERMAL WATER FROM NUCLEAR POWER PLANTS.

National Council for Research and Development, Jerusalem (Israel).

George Kligfield.

Developments in Water Quality Research, Jerusalem International Conference on Water Quality and Pollution Research, Jerusalem, Israel, p 173-178, June 1967. 6 fig, 1 ref.

Descriptors: *Nuclear power plants, *Thermal effluents, *Heated waters, Irrigation, *Subsurface irrigation, *Food crops, Agriculture, Temperature, Oregon.

Identifiers: Oregon's Willamet, Weyerhaeuser paper and pulp plant, McKenzie River.

An approach to the utilization of warm waste waters from a paper and pulp plant for agricultural benefits and demonstration of the concept of thermal enrichment as apposed to thermal pollution is presented in this paper. The procedure, which encompasses seven Oregon firms, began with the overhead sprinkling of warm water during three phases of the growing season: early spring to prevent freeze killing of fruitbuds, blossoms, and early fruit; normal ground crop irrigation; and fruitburn prevention during hot dry periods. A three year program for demonstration of the effects of heat energy contained in the irrigation waters to ascertain if warm water has a more beneficial effect on air temperature, humidity, and soil temperature than does the application of normal (cool) river or well water is given. Some conclusions are: (1) since this project aims at determining methods of introducing heat to soil, well and subsurface irrigation will be coupled with mulching techniques; (2) the tying together of nuclear power and agricultural promises major economic benefits; and (3) ponding, or a cooling lake, can be the key to the utilization of this water in the creation of new population centers and can provide as well, a tempered irrigation water supply. (Herrera-Van-derbilt) W71-04723

RELATION BETWEEN THE 'ITAI-ITAI' DIS-EASE AND THE POLLUTION OF WATER BY CADMIUM FROM A MINE, RIVER

Okayoma Univ., Kurashiki (Japan). Ohara Inst. for Agricultural Biology. J. Kobayashi.

5th International Water Pollution Research Conference, Pap I-25, San Francisco, California, July-August 1970. 6 fig, 3 tab, 2 ref.

Descriptors: *Heavy metals, *Metals, *Mine drainage, *Diseases, *Human pathology, Inorganic compounds, Water pollution effects, Mine wastes, Mining, Water pollution, Human diseases, Public health, Epidemiology, Toxicity. Identifiers: *Cadmium, Cadmium effects, Cadmi-

um pollution, Metals effects.

As a consequence of the discovery of a high content of Cd, Zn, and Pb in the tissues of the patients suffering from the itai-itai disease, which appeared

in a restricted district along the Jintsu River in Toyama Prefecture, Japan, there was a presumption that the cause of the disease was chronic poisoning by the heavy metals found in the waste water from a mine upstream. The following observations were made: (1) The itai-itai disease and damage to rice by the waste water appeared in the same place along the banks of the river during the same period. (2) A heavy accumulation of Cd and other metals was found in the patient's bones, internal organs, soil, and plants. (3) In animal experiments on rats it was proved that the rats fed by Cd excreted more Ca than that assimilated from the feed while the control group showed the opposite phenomena. From these results, it was made clear that the itai-itai disease was induced by cadmium in the waste water from the mine. (Novotny-Vanderbilt) W71-04726

SOME MICROBIAL-CHEMICAL INTERAC-TIONS AS SYSTEMS PARAMETERS IN LAKE

Ohio State Univ., Columbus. Microbial and Cellular Biology.

For primary bibliographic entry see Field 06A. W71-04758

SEA URCHIN POPULATION EXPLOSION IN SOUTHERN CALIFORNIA COASTAL WATERS.

California Inst. of Tech., Pasadena. W. M. Keck

Lab. of Engineering Materials. Wheeler J. North, and John S. Pearse.

Science, Vol 167, No 3915, p 209, January 9,

Descriptors: *Sewage, *Aquatic life, *Populations, Water pollution effects, Sewage effluent, Effluents, *Ecosystems, Ecology, California, Environmental effects, Coasts.
Identifiers: *Sea urchins, California coastline,

Overpopulation, Human population, Coastal pollu-

California coasts are experiencing the effects of the overpopulation of the sea urchin, Strongylocentrotus. The environmental changes that caused this overpopulation were wrought by man. Water enrichment by sewage effluents caused elimination of competitors and predators allowing the sea urchins to overpopulate. This abundance of sea urchins is preventing the growth of vegetation and kelp, thereby, upsetting the ecosystem. (Ensign-PAI) W71-04795

FIELD TOXICITY STUDIES AND JUVENILE SALMON DISTRIBUTION IN PORT ANGELES HARBOR, WASHINGTON,

Washington State Water Pollution Control Commission, Olympia. Charles D. Ziebell, Roland E. Pine, Alvin D. Mills,

and Richard K. Cunningham.

French, German, Spanish and Portuguese abstracts. Journal Water Pollution Control Federation, Vol 42, No 2, p 229-236, February 1970. 3 fig, 2 tab, 9 ref.

Descriptors: Water quality, *Pulp wastes, *Toxicity, Sludge, *Sulfides, *Salmon, Washington, Lethal limit, Fish toxins, Industrial wastes, Water pollution effects, Harbors.

Identifiers: *Port Angeles Harbor (Wash), Coastal pollution.

A study was made in Port Angeles Harbor, Washington, to determine the water quality conditions and the effects of pulp mill waste discharges on the condition and distribution of juvenile Pacific salmon. Sulfides from the anaerobic decomposition of sludge deposits in the bottom of the harbor seemed to be the primary cause of toxicity. Sulfide levels of 0.3 mg/l were toxic to juvenile salmon but effects were noticed at levels of 0.1 and 0.2 mg/l. Tide stages also influenced the level of toxicity. (Ensign-PAI) W71-04796

EFFECT OF PULP MILL EFFLUENT ON FAUNA OF SEA LOCH.

Dunstaffnage Marine Research Lab., Oban (Scotland)

T. H. Pearson.

Marine Pollution Bulletin, Vol 1, No 6, p 92-94, June 1970. 3 fig, 2 tab, 5 ref.

Descriptors: *Industrial wastes, *Pulp wastes, *Aquatic animals, Water pollution effects, Monitoring, *Benthic fauna, Benthos, Effluents.
Identifiers: Linnhe Loch, Eil Loch, Scotland, Coastal pollution.

The decision to erect an integrated pulp and paper mill which would discharge its wastes into the narrows between lochs Linnhe and Eil on the west coast of Scotland prompted establishment of a monitoring survey of the hydrographical and biological conditions to assess effects of the discharge. Bi-monthly samples of the hydrographical conditions and detailed sampling of the benthic and infauna of the lochs are included. (Ensign-W71-04797

SOME BIOLOGICAL EFFECTS OF OIL POL-

LUTION,
Orielton Field Studies Centre. Oil Pollution Research Unit. Eric B. Cowell.

Your Environment, Vol 1, No 3, p 84, 93-94, Summer 1970.

Descriptors: *Water pollution effects, Oil, *Ecosystems, *Toxicity, *Cleaning, Seepage, Accidents, Detergents.

Identifiers: Limpets, Seaweed control, Population imbalance, *Oil pollution.

Investigating the biological effects of oil pollution and the following shore cleaning operations is complex because the ecosystem is a system of inter-related reactions between the abiotic environment and the organisms that are dependent upon it. It is established that the volatile aromatic compounds in crude oil are the most toxic to wildlife, yet further damage can be done by the detergent/emulsifier beach cleaning methods. If in the process of beach cleaning only one species is killed in sufficient numbers then the ecological chain reaction that follows will ensure wide spread damage to the system and recovery will be slow. These problems with specific examples are presented in detail. (Ensign-PAI) W71-04802

ANNULMENT AZIRIDINE (APHOLATE) - IN-DUCED GROWTH INHIBITION IN THE ESTUARINE FLAGELLATE TETRASELMIS SUBCORDIFORMIS BY SOME PURINES AND PYRINIDINES, Bureau of Sport Fisheries and Wildlife, Highlands,

N.J. Sandy Hook Marine Lab.

J. C. Prager, and J. B. Mahoney

Journal of Protozoology, Vol 16, No 1, p 187-190, 1969. 1 fig, 2 tab, 26 ref.

Descriptors: *Estuaries, *Pesticides, Invertebrates,

*Toxicity, Aquatic animals, *Sterilants.
Identifiers: *Marine flagellates, Tetraselmis subcordiformis, *Aziridines.

An insect chemosterilant at 850 ppm apholate reduced growth of the marine flagellate Tetraselmis subcordiformis by 50% in 21 days. Two other aziridinyl chemosterilants tested were more toxic than apholate-values agreeing with those for some estuarine animals. Apholate acted directly on the organisms. Comparatively small molar additions of orotic acid, adenine, guanine and thymine to apholate-poisoned cultures annulled the growth inhibition. Mode of action of aziridinyl chemosterilants by activity annulment is also discussed. (Ensign-W71-04806

OYSTERS AND HUMAN VIRUSES: EFFECT OF SEAWATER TURBIDITY ON POLIOVIRUS UP-TAKE AND ELIMINATION.

Gulf Coast Water Hygiene Lab., Dauphin Island, Ala.

Frederick E. Hamblet, William F. Hill, Jr., Elmer W. Akin, and William H. Benton.

American Journal of Epidemiology, Vol 89, No 5, p 562-571, May 1969. 2 fig, 6 tab, 28 ref.

Descriptors: *Water pollution effects, *Viruses, *Oysters, *Human diseases, *Turbidity, Water purification.

Identifiers: *Poliovirus, Uptake, Elimination, Crassostrea virginica, Coastal pollution.

The effect of turbidity, in a flow-through seawater system, on Oyster accumulation and elimination of poliovirus was studied. Data indicated that in the virus accumulation stage oysters in low turbidity seawater (16-24 ppm) over a 24 hour period accu seawater (10-24 ppm) over a 24 nour period accumulated about three times as much virus (PF U/ml) as those oysters in high turbidity seawater (S4-77 ppm). Turbidity (8-80 ppm) did not significantly influence virus elimination in oysters in the 24 hour period. In 48 hours no virus was found in the oysters. It is concluded that oysters in continuously flowing seawater of either high or low turbidity can eliminate virus in 48 hours in a controlled environ-ment. (Ensign-PAI) W71-04808

IMPLICATION OF A MARINE AMEBA IN THE DECLINE OF ESCHERICHIA COLI IN SEA-

WATER, Harvard Univ., Cambridge, Mass. Div. of Engineer-ing and Applied Physics. Ralph Mitchell, and Shlomit Yankofsky.

Environmental Science and Technology, Vol 3, No 6, p 574-576, June 1969. 3 fig, 12 ref.

Descriptors: Water pollution effects, *Microorganisms, *Biodegradation, Populations.
Identifiers: *Lysis, *Escherichia coli, *Vexillifera telmathalassa, Marine ameba.

Escherichia coli decline in seawater and the increase of a specific microbial population capable of causing lysis of the intestinal bacteria was observed. Pure cultures of the marine ameba were obtained and the organism was identified as Vexillifera telmathalassa. Adding this marine ameba to natural seawater with E. coli resulted in a rapid kill of the intestinal bacterium. The decline of intestinal bacteria in the sea and the importance of the marine microflora is discussed. (Ensign-PAI) W71-04811

LEVELS OF STABLE ZN AND 65ZN IN CRAS-SOSTREA VIRGINICA FROM NORTH SOSTREA CAROLINA,

Bureau of Commercial Fisheries, Beaufort, N.C.

Radiobiological Lab. Douglas A. Wolfe. Journal of the Canada Fisheries Research Board, Vol 27, No 1, p 47-57, January 1970. 2 fig, 3 tab, 36 ref.

*Radioactive wastes, *Zinc Shellfish, *Oysters, *Estuaries, Descriptors: radioisotopes, North Carolina.

Identifiers: Crassostrea virginica, *Zinc.

An investigation of zinc concentration in oysters in relatively unpolluted estuaries in North Carolina demonstrated high variability. Internal tissues such as the adductor muscle and pericardial sac, had zinc levels less than half those of external tissues. North Carolina oysters contained 2-20pCi 65Zn from fallout per 100g wet weight during the period from 1964-66. From 1965-66 specific activity of 65Zn in these oysters was from 90-300pCi/g Zn, and was declining. (Ensign-PAI) W71-04812

OIL IN THE ECOSYSTEM, Robert W. Holcomb.

Group 5C—Effects of Pollution

Science, Vol 166, No 3902, p 204-206, October 10, 1969.

Descriptors: *Oil wastes, *Water pollution effects, *Aquatic life, *Ecology.

Pollution of the marine environment by oil spills is more oil being transported longer distances in larger tankers. Little is known about the handling of oil spills or the effects of oil on the environment. Birds suffer mortality in high numbers, and entire animal populations have been eradicated from certain areas, but more research is needed. Various programs to study ecology are underway on an international scale in the hopes of finding a solution to the oil problem. (Ensign-PAI) W71-04813

DISSOLVED FREE AMINO ACIDS IN SEA WATER AND THEIR CONTRIBUTION TO THE NUTRITION OF SEA URCHINS,

California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.

Mary E. Clark. Mary E. Clark.
California Institute of Technology, Pasadena, W.
M. Keck Laboratory of Environmental Health Engineering. Annual Report, Chapter 6, p 70-93, July 1968 - June 1969. 2 fig, 7 tab, 48 ref.

Descriptors: *Sewage, *Outlets, *Nutrients, *Amino acids, *Marine animals.
Identifiers: *Sea Urchins, Glycine, Serine, Alanine, Aspartic acid.

A study of the dissolved free amino acids in sea water from the Los Angeles Basin and uptake rates of the four major amino acids by a local species of urchins Strongylocentrotus purpurats is presented. The method of DFAA Analysis, actual DFAA concentrations found, and the contribution which glycine, serine, alanine and aspartic acid make to the nutrition of the urchins is described. Approximately 50% of the daily nutrient requirements for urchins living near sewage outfalls can be fulfilled by uptake of the DFAA. (Ensign-PAI) W71-04814

STRONTIUM-90 AND CESIUM-137 LEVELS IN TISSUES OF FIN WHALE (BALAENOPTERA PHYSALUS) AND HARP SEAL (PAGOPHILUS

GROENLANDICUS),
Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.

E. R. Samuels, M. Cawthorn, B. H. Lauer, and B. E. Baker.

Canadian Journal of Zoology, Vol 48, No 2, p 267-269, March 1970. 1 tab, 10 ref.

Descriptors: *Mammals, *Radioisotopes, *Strontium radioisotopes, *Cesium, Water pollution ef-

Identifiers: *Whales, *Seals.

Strontium-90 and Cesium-137, in eleven different tissues of the fin whale and two tissues of the harp seal were identified. The highest concentration of strontium-90 was found in whale blubber. Muscle tissue seemed to contain more Cesium-137 than did the other tissues. The average concentration of Cesium-137 in whale muscle was 4.5 Ci/g ash and in adult seal muscle was 2.5 pCi/g ash. (Ensign-PAI) W71-04817

SALMONELLA TYPES ISOLATED FROM THE GULF OF AARHUS COMPARED WITH TYPES FROM INFECTED HUMAN BEINGS, ANIMALS, AND FEED PRODUCTS IN DENMARK,

Andrus Univ. (Denmark). Inst. of Hygiene.
K. Grunnet, and B. Brest Nielsen.
Applied Microbiology, Vol 18, No 6, p 985-990,
December 1969. 3 fig, 4 tab, 16 ref.

Descriptors: *Waste water disposal, Pollutants, *Bacteria, Food chains. Identifiers: *Salmonella, Gulf of Aarhus, Denmark.

The Gulf of Aarhus, which receives waste water from industries and from 100,000 inhabitants was investigated for Salmonella over a two year period. Distribution of Salmonella types in the Gulf of Aarhus and in Oeresound, from 1966 to 1968 and the distribution in man, animals, and foodstuffs during the time from 1960 to 1968 in Denmark as a whole are shown. The classical chain of infection feedstuffs-animals-food-man is not indicated in Denmark. Though there are a great many human cases, the examined types of Salmonella were not found in animals or foodstuffs during this period. **Oualitative Salmonella examinations to supplement** the E. coli counts when examining polluted waters is suggested. (Ensign-PAI) W71-04821

THERMAL REQUIREMENTS TO PROTECT

AQUATIC LIFE, National Marine Water Quality Lab., West Kingston, R.I.

Clarence M. Tarzwell.

Abstracts in German, Portuguese and Spanish. Journal Water Pollution Control Federation, Vol 42, No 5, p 824-828, May 1970.

Descriptors: Water quality control, *Temperature Descriptors: water quanty control, *Temperature control, *Oxygen requirements, *Aquatic life, Animal metabolism, Seasonal, Temperature, *Thermal pollution.

Identifiers: Temperature effects, Population imbalance, Spawning, Nest-building fish.

Temperature and oxygen must be considered in determining water quality requirements because aquatic organisms are cold-blooded and their metabolism is dependent on the temperature of the water. Through long periods of development these organisms adjusted to certain temperatures and daily and seasonal fluctuations in temperature. In setting temperature criteria, it is desirable to have a nationwide standard, and to maintain these fluctuations. The National Technical Advisory Committee of Water Quality Requirements for Aquatic Life indicated uniform allowable increase above the monthly average of the daily maximum temperatures. These increases are influenced by season, the most sensitive species and life stages in the biota, and the main taxonomic groups present. Temperature control is important to the abatement and control of pollution as well as conserving our aquatic life resources. (Ensign-PAI) W71-04823

WHAT OIL DOES TO ECOLOGY,

California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials. Charles T. Mitchell, Einar K. Anderson, Lawrence

G. Jones, and Wheeler J. North.

Abstracts in French, German and Spanish. Journal Water Pollution Control Federation, Vol 42, No 5, p 812-818, May 1970. 8 fig, 7 ref.

Descriptors: Water pollution effects, Oil, *Seepage, *Ecosystems, *Toxicity, Animal populations, Plant populations, Ecology.

Identifiers: Tampico spillage, Santa Barbara spillage, Community changes, Population imbalance, Kelp, *Oil pollution.

Criteria for evaluating ecological consequences are presented and the observations of two spillages are explained in terms of the biological effects of exposure to oil. The Tampico spillage of diesel fuel in a cove on the Coast of Mexico in 1957 produced definable changes for approximately 5 miles. The Santa Barbara spillage of crude oil affected certain bird species but did not cause significant mortalities among intertidal and shallow subtidal organisms. These two accidents indicate that the ecological reactions to oil spillage vary with the character of the pollutant, the oceanographic conditions and the extent of the success of cleanup operations. (Ensign-PAI) W71-04824

EFFECTS OF POLLUTION ON ESTUARINE ECOSYSTEMS I. EFFECTS OF EFFLUENTS FROM WOOD-PROCESSING INDUSTRIES ON THE HYDROGRAPHY, BOTTOM AND FAUNA OF SALTKALLEFJORD (W. SWEDEN), Institute of Marine Research, Helsinki (Finland)

Pauli Bagge. Findland. Merentutkimoslaitoksen Julkaisu, Havsforskningsinstitutets Skrift No 228, p 3-18. 28 fig, 23 tab.

Descriptors: *Estuaries, *Effluents, *Wood wastes, *Pulp and paper industry, *Hydrography, *Ecosystems, *Benthic fauna, Water pollution effects.

Identifiers: *pH, *Oxygen content, *BOD, *Transparency.

The hydrography, bottom and fauna of the Gullmar Fjord, Sweden were studied from 1964-65. Effluents from a sulphite pulp and paper mill were discharged into Satlkallefjord, the central study area, for over 80 years. Sewage from nearby communities was also discharged into the fjord. Oxygen content, pH, chemical and biochemical oxygen demand and transparency were all effected. Pollution effects on the fauna were both quantitative, the distribution of the communities and qualitative, decreased diversity of the fauna in polluted areas. (See also W71-04827) (Ensign-PAI) W71-04826

EFFECTS OF POLLUTION OF ESTUARINE ECOSYSTEMS II. THE SUCCESSION OF THE BOTTOM FAUNA COMMUNITIES IN POL-LUTED EXTUARINE HABITATS IN THE BAL-TIC-SKAGERAK REGION,

Institute of Marine Research, Helsinki (Finland). Pauli Bagge

Findland. Merentutkimuslaitoksen Julkaisu Havsforskningsinstitutets Skrift No 228, p 119-130, 1969. 5 fig, 2 tab, 12 ref.

Descriptors: *Estuaries, *Effluents, *Ecosystems, *Benthic fauna, *Water pollution effects, *Inhibi-Identifiers: *Salinity.

In five polluted estuaries, representing different salinity ranges, in the Baltic-Skagerak area comparisons of the macrofaunal communities were investigated. The secondary succession of the faunal communities due to pollution was very rapid, particularly where the exchange of water is limited by ice-cover, sills, or poor circulation. Aquatic organisms as indicators of the degree of pollution or of clean water is discussed. (See also W71-04826) (Ensign-PAI) W71-04827

BOTTOM FAUNA IN A SEA AREA NORTHWEST OF HELGOLAND, SELECTED FOR INDUSTRIAL WASTE DISPOSAL, (IN GERMAN).

Konrad Stripp, and Sebastian Gerlach. Bremerhaven, Institut Fuer Meeresforschung Veroeffentlichungen, Vol 12, No 2, p 149-156, 1969. 4 tab, 5 ref.

Descriptors: *Industrial wastes, *Waste disposal, *Bottom fauna. Identifiers: *Sulfuric acid, *Ferrous sulphate, North Sea, Helgoland.

In 1967 and 1968, benthos stations in the area of disposal of industrial wastes containing sulphuric acid and ferrous sulphate were investigated using van-Veen-grabs. The area selected near Helgoland belongs to the Venus-gallina-community which has an average of 375 macrofauna individuals per m2. The more productive Echinocardium-cordatum-Amphiura-filiformis-community is approximately one nautical mile to the southwest. Because the residual currents are directed toward the northeast this region should not be affected by the pollution. (Ensign-PAI) W71-04828

Waste Treatment Processes—Group 5D

A MARINE KILL ON NEW JERSEY WRECKS. Larry Ogren, and James Chess

Underwater Naturalist, Vol 6, No 2, p 4-12, 1969. 5 fig, 2 tab.

Descriptors: *Ships, *Accidents, *Fishkill, *Mortality, *Ecology.
Identifiers: Submerged shipwreck.

Two submerged wrecks near Bay Head, New Jersey were the focal points of a massive fish kill in September 1968. Mortalities were reported for seven weeks and effected fish, lobsters, crabs, starfish, clams and mussels. Several environmental imbalances occurred preceding this event which may or may not be related to the kill. (Ensign-PAI) W71-04836

PHYSICAL AND CHEMICAL FACTORS AF-FECTING VASCULAR AQUATIC PLANTS IN SOME ACID STREAM DRAINAGE AREAS OF THE MONONGAHELA RIVER,

West Virginia Univ., Morgantown. Dept. of Biolo-

gy.
J. A. Moore, and R. B. Clarkson.

Proceedings, West Virginia Academy of Science, Vol 39, p 83-89, 1967. 2 tab, 15 ref. OWRR A-005-WVA (2).

Descriptors: *Aquatic plants, *Acid mine water, *Water pollution effects, *Rooted aquatic plants, *Submerged plants, Water pollution, Aquatic weeds, Cattails, Floating plants, Pondweeds, Plants, Aquatic life, West Virginia, Water quality. Identifiers: *Vascular aquatic plants, Monongahela River basin.

Six study areas were established on three acid mine-water polluted rivers in West Virginia-the Monongahela, Tygart Valley, and West Fork. The study areas included four areas containing vascular aquatic plants and two areas devoid of such plants. Each area was analyzed chemically for nitrogen, phosphate, calcium, total acidity, iron, and pH Physical factors studied were the composition of the substrate, the velocity of the water and the fluctuation of the water level. From a stepwise discriminant analysis comparing areas of plants with areas devoid of plants, nitrogen, calcium, total acidity, iron, pH and water velocity were determined to be non-limiting and statistically insignificant. Substrate was determined to be the primary physical factor in determining plant distribution. Phosphate and water fluctuation also were significant. (See also W71-04418)
W71-04850

5D. Waste Treatment Processes

DEVELOPMENT OF DESALINATION MEM-BRANES,

General Aniline and Film Corp., Easton, Pa. Central Research Lab.

For primary bibliographic entry see Field 03A. W71-04426

SURVEY OF THE ION EXCHANGE PROCESS FOR DESALINATION APPLICATIONS.

Control Systems Research, Inc., Arlington, Va. For primary bibliographic entry see Field 03A. W71-04429

COOLING TOWERS Q AND A.

American Inst. of Chemical Engineers, New York. Water Committee.

Industrial Water Engineering, Vol 7, No 11, p 19-21, Nov 1970.

Descriptors: *Cooling towers, *Water cooling, Ion exchange, Thermal pollution, Waste water treat-

Identifiers: *Polyphosphates, *Chromate recovery,

Three main topics are considered: blowdown and make up, air cooling, and corrosion control in the tower. Due to its simplicity, continuous blowdown through an overflow in the cooling tower coldwater basin is usually employed. A change in the basin water level, controlled by the makeup waterfloat value, regulates the amount of blowdown. The oil and scum floating on the surface of the water is continuously removed from the system, but no provisions are made for sludge removal. It is said that 70-80% of excess plant heat in new petroleum refineries, petrochemical and natural processing plants is removed at a level favorable for air cooling. Ion exchange can be used for zinc-chromate blowdowns as well as for blowdowns free of zinc. (Herrera-Vanderbilt) W71-04436

COOLING TOWERS, THE ENVIRONMENT AND THE FUTURE,

IIT Research Inst., Chicago, Ill.

Eric Aynsley.

Cooling Tower Institute Meeting, Snowmass-at-Aspen, Colorado, June 22-25, 1970. 12 p, 5 fig, 3

Descriptors: Cooling towers, Cooling, Thermal pollution, Air-pollution effects, Atmosphere pollution, Pollutants, Evaporation, Heat, Heat pollution.

The paper deals with the use of natural draft cooling towers for cooling of process water and their effects on the environment. The use of the draft cooling towers has increased exponentially since 1962 when the first one was put into operation. IIT Research Institute has completed a study of tower emissions and possible related environmental effects. Hyperbolic tower have much larger point emissions of heat and water vapor and have the potential to form dense, extensive fogs. Mixing of the tower and stack plumes was confirmed. There are a number of effects, mechanisms and interactions occurring both with cooling tower plumes and tower plumes mixed with nearby stack emissions. Some problems concerned with the salt emission from cooling systems using sea water for cooling are pointed out. (Novotny-Vanderbilt) W71-04440

COOLING TOWER APPLICATION,

Kohloss (Frederick H.) and Associates Inc., Honolulu, Hawaii Frederick H. Kohloss.

American Society of Heating, Refrigerating and Air-Conditioning Engineers Journal, p 49-52, Aug 1970. 3 fig, 1 tab.

Descriptors: Cooling towers, Air conditioning, Structures, Water treatment, Performance, Water cooling, Waste water treatment. Identifiers: Blow-through, Capacity, Air flow.

Cooling towers permit recirculation and reuse of water which has picked up heat, in a refrigeration condenser or other device, by having atmospheric air contact the water, and by evaporating a little of water to cool the rest of it. Among the types of smaller cooling towers available, the application engineers choice is dictated by performance, weight, height, power consumption, noise, building code requirements, fire code requirements, and most of all capital cost. If a tower is not level, performance will probably suffer from uneven distribution of water through the fill. Structurally adequate may be too limber to avoid vibration transmission. This can be overcome by soft-spring mounts with large deflections. Blow-through tower design is extremely susceptible to non-uniform airflow. Chemical analysis of water should be known in order to preplan the bleed rate. Usually on larger systems, water treatment for control of pH, a corrosion inhibitor, scale control, and biocides are all employed. Restriction of airflow at the cooling tower inlet and discharge are the major cause of reduced tower capacity. Many published applica-tions recommendations suggest a design wet bulb temperature equaled or exceeded for 5% of the

hours of the few hottest months of the year. (Upadhyaya-Vanderbilt) W71-04442

MICROPROBE TECHNIQUES FOR DETER-MINING DIFFUSIVITIES AND RESPIRATION RATES IN MICROBIAL SLIME SYSTEMS,

Clemson Univ., S.C. Dept. of Environmental Systems Engineering. H. R. Bungay, W. J. Whalen, and W. M. Sanders.

Biotechnology and Bioengineering, Vol XI, No 5, p 765-772, May 1969. 2 fig, 2 tab, 5 ref.

Descriptors: *Slime, *Mass Transfer, *Diffusivity, Diffusion, Boundary processes, Dissolved oxygen, Microorganisms, Bacteria, Waste water treatment, Biological treatment.

Identifiers: Microbial slime films, *Microprobe, Steady state, Transient, Oxygen electrode, Gradient, Differentiation.

Microbial slime films are used in a variety of processes. They have been adapted directly from the natural environment for use in trickling filters. The critical factor controlling employment of these thin films is the mass transfer to and within them. In this instance, oxygen concentration near the surface and within a biological film was monitored using a microprobe oxygen electrode. With dilute medium, oxygen consumption was stable, indicating substrate limitation. With concentrated media, oxygen concentratior dropped indicating that oxygen supply was limited. Results indicated that substrate could be stored under conditions of high concentration, and then utilized later. This was not possible for oxygen because of its relatively low solubility. (Lowry-Texas) W71-04484

THE ISOLATION OF VIRUSES FROM SEWAGE AND TREATED SEWAGE EF-FLUENTS,

National Institute for Water Research, Pretoria (South Africa).

Water Pollution Control, Vol 69, No 4, p 430-455, 1970. 1 table, 31 ref.

Descriptors: *Vriuses, *Epidemiology, *Public health, Microbiology, Microorganisms, Diseases, Flocculation, Filtration, Chlorination, Water purification, E. Coli, Disinfection, Waste water treat-

Identifiers: Roll tube assay method, Plaque Assay.

There are a great number of viruses in sewage and yet few virus epidemnics have been attributed to drinking water although current epidemiological methods may not be sensitive enough to detect viral transport via water. Some water purification processes reduce the number of eneric viruses in sewage and although physical and chemical procedures such as flocculation, sand filitration, and chlorination result in further removal or inactivation, no system so far developed entirely eliminates these viral particles. The current methods for viral quantification are limited and new techniques have been developed or are under investigation. Different viruses react in a different manner than E. Coli to most disinfection procedures so E. Coli cannot be used as a contamination indicator. (Ellis-Texas) W71-04485

COLLECTION AND DISPOSAL OF FARM

Ministry of Agriculture (Northern Ireland). J. S. V. McAllister.

Water Pollution Control, Vol 69, No 4, p 425-429, 1970, 6 tab, 5 ref.

Descriptors: *Farm wastes, *Slurries, Sewage, Descriptors: *Farm wastes, *Siurnes, Sewage, Aeration, Incineration, Biochemical oxygen demand, Farm lagoons, Water pollution, Nitrogen, Ammonia, Methane, Hydrogen sulphide, Phosphorous, Waste water disposal, Waste water

Group 5D—Waste Treatment Processes

Identifiers: *Pig slurries, *Poultry droppings, *Cattle excreta, Silage.

Improved farming techniques, suburban development, and a wider realization of the necessity to control pollution of the atmosphere and water supplies have increased the problem of farm waste col-lection and disposal. Generally, in Europe farm wastes are collected in the form of a slurry but disposing of this slurry is a problem. The use of this slurry as a manure has certain drawbacks and alternative methods of disposal such as drying, incineration, aeration treatment, or synthesis of feeding stuffs are explored. (Ellis-Texas) W71-04486

NUTRIENT REMOVAL AND EFFLUENT POLISHING SYSTEMS, Dravo Corp., Pittsburgh, Pa.

Gerald L. Lamb.

Water and Sewage Works, Vol 117, No 11, p 396-398, November 1970. 2 fig, 1 tab.

Descriptors: *Effluents, *Nitrates, *Phosphates, Biochemical oxygen demand, Coagulation, Aeration, Activated sludge, Filtration, Chlorination, Carbon, Digestion, Waste water treatment. Identifiers: *Effluent polishing, *Phosphate removal, Nitrate removal, Nutrient removal.

A three part test program conducted by Dravo Corporation at Indian Lake Sewage Treatment Plant of the North Huntington Township Municipal Authority near Pittsburgh involved studies of effluent polishing, phosphate removal, and denitrification. The results obtained by their process is 98% removal of BOD5, 80% removal of phosphorous, but denitrification needs high temperatures if practical rates of nitrogen removal are to be obtained. (Ellis-Texas) W71-04487

TANNERY PRE-TREATMENT PLANT DRASTI-CALLY CUTS BARRE'S TREATMENT PLANT

Water and Pollution Control, April 1970, p 61-62.

Descriptors: *Waste water treatment, *Industrial wastes, Hydrogen ion concentration, Biochemical oxygen demand, Cost, Sedimentation, Sludge, Slime, Organic wastes.

Identifiers: *Tannery wastes, Suspended solids, Ether solubles, Barrie (Ontario, Canada).

Gore and Storrie Limited of Toronto, Canada was retained to design and supervise construction of a pre-treatment plant for tannery wastes. Prior to design sedimentation tests, sludge studies, the effect of polyelectrolytes, and water use reduction were scrutinized to determine how they affected treatment. The plant was designed and built by 1968 at a total cost of \$195,000 and consisted of facilities to provide for screening, flow equilization, pre-aeration, settling, sludge removal and storage scum removal, flow metering, tank truck removal of scum and sludge, and unwatering. This pretreatment significantly reduced the sludge volume in the city's treatment plant. (Ellis-Texas)
W71-04488

THE INFLUENCE OF TRIVALENT CHROMI-UM ON THE BIOLOGICAL TREATMENT OF DOMESTIC SEWAGE,

British Leather Manufacturers' Research Association, Egham (England).
D. A. Bailey, J. J. Dorrell, and K. S. Robinson.

Water Pollution Control, Vol 69, No 1, p 100-110, 1970. 5 fig, 8 tab, 30 ref.

Descriptors: *Chromium, *Sewage treatment. *Anaerobic digestion, *Biological treatment, Filtration, Ammonia, Nitrogen, Nitrification, Sludge, Waste water treatment, Sludge diestion. The literature contains many references on the effects of chromium on sewage treatment, but it mostly concerns hexavalent chromium. Experiments were conducted to determine the effect of trivalent chromium on anaerobic sludge digestion, biological filtration, and activated sludge. The data collected indicates that the acceptable levels of concentration of trivalent chromium in domestic sewage for effective biological treatment of such sewage are much higher than has been previously assumed. (Ellis-Texas) W71-04489

SALMONELLA-ITS PRESENCE IN AND REMOVAL FROM A WASTE WATER SYSTEM, Rijksinstituut voor de Volksgezondheid, Utrecht (Netherlands).

E H. Kampelmacher, and L. M. van Noorle

Jansen.

Journal Water Pollution Control Federation, Vol 42, No 12, p 2069-2073, December 1970. 1 fig, 3 tab, 15 ref.

Descriptors: *Salmonella, *Cultures, Enteric bacteria, Microorganism, Pathogenic bacteria, Waste water treatment, Sewage treatment, Trickling fil-ters, Sedimentation, Retention, Gamma rays,

Identifiers: *Salmonellosis, Gamma scintillation counter, Radioactive nuclide, Most probable number (MPN).

A study was made to determine the degree of contamination by Salmonella of waste water by qualitative and quantitative methods in a waste treatment plant in a Dutch town of over 100,000 people. An attempt was also made to establish whether salmonella is eliminated by the trickling filter process. When 3 x 10 in S. utrecht germs were added to the influent, an average of 60 germs/100 ml effluent were recovered in 10.5 hours while normal operation shows 100 germs/100 ml of Salmonella germs. It can be maintained that 10 upper 10 salmonella germs enter the plant each hour while 10 upper 9 salmonella germs are released with the effluent each hour. The reduction in the concentration of salmonella is quite small and disinfection of the effluent merits consideration. (Ellis-Texas) W71-04492

TREATMENT OF WINE DISTILLING WASTES BY ANAEROBIC DIGESTION,

Council for Scientific and Industrial Research, Pretoria (South Africa).

G. J. Stander.

O.J. Staticus Proceedings 22nd Industrial Waste Conference, May 2, 3, 4, 1967, Purdue University, Vol L II, no 3, p 892-907, July 1968. 8 fig, 4 tab, 6 ref.

Descriptors: *Anaerobic digestion, Domestic wastes, Sewage treatment, Waste water treatment, Stabilization, Biochemical oxygen demand, Chemical oxygen demand, Phosphates, Nitrogen, Costs. Identifiers: *Wine distillery wastes, Spent wine, Ethyl alcohol, South Africa, Dorr-Oliver

A program of operational research with a full-scale treatment plant located in the main wine producing area of South Africa has been undertaken by the Cape Regional Laboratory of the National Institute for Water Research (NIWR). Laboratory and pilot scale studies have been conducted from 1948 to date and have indicated that anaerobic digestion might provide a practical method for dealing with wine wastes. The full-scale treatment plant consists of a modified 'Dorr-Oliver Clarigester' and the description and operation of this plant is discussed. Many unknown factors which existed in regard to the biological, metabolic pathways, technological, and physical aspects of the practical operation of an anaerobic digestor are included. The effluent from the anaerobic digestion of spent wine still contains approximately 1.8% of its original COD which amounts to about 400 mg/l and this needs additional stabilization which can be accomplished in conventional sewage treatment. The cost of this type of treatment is approximately 56 cents per 1000 gallons. (Ellis-Texas) W71-04493

COMBINED WASTE TREATMENT AT GRAND ISLAND, NEBRASKA,

Black and Veatch, Kansas City, Mo.
W. R. Gibbs, and H. Benjes, Jr.
Proceedings, 22nd Industrial Waste Conference,
May 2, 3, 4, 1967, Purdue University, Vol LII, No
3, p 800-812, July 1968. 6 fig, 5 tab.

Descriptors: *Municipal wastes, *Industrial wastes, *Activated sludge, Capital costs, Operating costs, Biochemical oxygen demand, Aeration, Sedimentation, Ventura flumes, Nebraska, Waste water

Identifiers: Meat packing wastes, Milk processing, Steam-electric generation, Suspended solids, Parshall Flume, Grit chamber, *Combined waste treatment.

Studies were undertaken to determine the nature of the industrial wastes, of determining whether the domestic and industrial wastes could be treated more economically and efficiently in combined or separate facilities, and which processes offered the greatest advantages. These exhaustive studies led to the conclusion that maximum efficiency and economy would be realized by combined treatment of domestic and industrial wastes in a new treatment plant incorporating the complete mixing activated sludge process, and abandonment of the existing treatment facilities. A discussion of the planning, design, operation, problems, and cost are included. Studies are continuing of operational controls and process modifications which are anticipated to increase the treatment efficiency and reduce operating costs. (Ellis-Texas) W71-04494

MICRO-STRAINING AND OZONIZATION OF WATER AND WASTE WATER,

Glenfield and Kennedy Ltd., London (England). P. L. Boucher.

Proceedings, 22nd Industrial Waste Conference, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 771-787, July 1968. 6 tab, 13 ref.

Descriptors: *Ozone, Water purification, *Water reuse, *Chlorination, *Coagulation, Filtration, Filters, Waste water treatment, Sewage treatment, Particle size, Electrophoresis, Microbiology, Microorganisms.

Identifiers: *Microstraining, Micellation/Demicellation, Rapid-sand filtration.

A brief review of Micro-Straining, Ozonization, and Micellation/Demicellation is conducted preliminary to giving an account of the investigation done at the Eastern Sewage Works of the London Borrough of Redbridge. A series of tests was run to determine the effect of the microzon and Micellation/Demicellation processes on the physical, chemical, and microbiological conditions of a typical sewage effluent. SS concentrations decreased progressively but the largest reduction was effected by the micro-strainer. Most of the nitrite was oxidized by ozone but TDS, N, and P compounds were virtually unoffected. Colored compounds were virtually unaffected. Color and turbidity removal was effective but organic matter removal was effective of organic micro-straining made virtually no difference to the counts of any microbiological groups but while ozone killed a majority of the organisms it did not produce a sterile effluent. Electrophoresis and Particle size distributions were also studied as well as the cost of operating this treatment process. (Ellis-W71-04495

BIODEGRADATION OF LAS BENZENE RINGS IN ACTIVATED SLUDGE,

Monsanto Co., St. Louis, Mo. R. D. Swisher.

Waste Treatment Processes—Group 5D

Proceedings, 22nd Industrial Waste Conference. May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 375-392, July 1968. 7 fig, 3 tab, 18 ref.

Descriptors: *Biodegradation, *Activated sludge, *Sewage treatment, Biological treatment, Water purification, Surfactants, Detergents, Sulfonates, Linear alkyl sulfonates, Colorimetry, Spectrophotometry, Waste water treatment.

Identifiers: *LAS Benzene rings, Warburg Warburg

Respirometry.

Almost complete removal of the benzene rings of LAS can be accomplished by activated sludge under a variety of conditions. An experiment was conducted to study the ring degradation of 3-phen-yl and 6-phenyldodecane. A small residual UV adsorption corresponding to a few percent of the initial rings were encountered and may have been caused by: (1) insufficient time for complete degradation; (2) the possibility that the residual material originates in small amounts of impurities present in the samples; (3) and the possibility that two biodegradation pathways are involved, a major one leading to complete destruction, and a minor one terminating in a dead end somewhere short of complete degradation. However, this effect is of minor consequence, since ring degradation proceeds to the extent of 85-90% or more with either isomer. Continuous and semi-continuous treatment tests were conducted and led to the conclusion that a 24 hour semi-continuous feed is not a more vigorous biodegradation system than a continuous flow with a shorter residence time. Investigations have shown that effluents from the biodegradation of LAS are non-toxic at LAS levels of 100 mg/l or more which is much higher than occur in the field. (Ellis-Texas) W71-04496

PROCESS CONTROL FOR ACTIVATED SLUDGE.

General American Transportation Corp., Niles, Ill. Carl Zaander, and Bernard Johnson.

Proceedings, 22nd Industrial Waste Conference, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 403-413, July 1968. 6 fig, 1 tab.

Descriptors: *Activated sludge, *Mathematical models, Aeration, Effluents, Dissolved oxygen, Biochemical oxygen demand, Waste water treat-

ment, Water pollution control.

Identifiers: *Return sludge flow, Return sludge concentration, Recirculation.

General American was asked to study the feasibility of automating an activated sludge plant. To do this parameters requiring measurement had to be identified and interrelationships between the various parameters had to be discovered in order to affect continuous control. Once mathematical models were set up it became apparent that sludge recycle had an important effect on the quantities which required measurement and control. Consequently, three types of recirculation schemes were considered: (1) constant BOD reduction ratio, (2) constant BOD in effluent, (3) and constant weight of returned sludge. These processes possess a certain measure of self regulation which allows them to cope with changes in the influent and the environment but each process has one unique measurement requirement in the return flow. (Ellis-Texas) W71-04497

THE LARGEST OXIDATION DITCH IN THE WORLD FOR THE TREATMENT OF INDUS-TRIAL WASTES.

Nederlandse Staatsmijnen N. V., Geleen.

Proceedings, 22nd Industrial Waste Conference, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 717-730, July 1968. 15 fig, 4 tab.

Descriptors: *Oxidation, *Activated sludge, *Degradation, Industrial wastes, Biochemical ox-*Activated sludge, ygen demand, Chemical oxygen demand, Nitrogen, Nitrification, Ammonia, Denitrification. Phosphorous, Hydrogen ion concentration, Cost analysis, Waste water treatment, Biological treat-

Identifiers: *Oxidation ditch, Pasveer ditch, Netherlands.

An investigation was made of the biological treatment of waste water coming from two coking plants, a plant whose effluent contained chemicals used in the preparation of polyethylene and formal-dehyde, and a third type of plant which discharged large amounts of organic wastes. A comparison of the activated sludge process versus the oxidation was made and the latter process was deemed to be more appropriate for treatment of this particular waste. The biological purification under nitrification and denitrification conditions, the trouble caused by a shortage of phosphorous, maximum capacity of the ditch and plans to enlarge the capacity, capital and operating costs, and other data on the Pasveer Ditch are discussed. (Ellis-Texas) W71-04498

NITRO-CELLULOSE INDUSTRIAL WASTE,

Technische Hochschule, Hanover (West Germany). Inst. of Sanitary Engineering. Klaus Mudrack.

Proceedings, 21st Industrial Waste Conference, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, p 656-664. 7 fig, 12 ref.

Descriptors: *Cellulose, *Acidity, *Alkalinity, *Neutralization, Corrosion, Denitrification, Hardness (Water), Sulfates, Microorganism, Metabolism, Centrifugation, Purification, Activated sludge, *Chemical wastes, Waste water treatment, Industrial wastes, Sulfur.

Identifiers: Nitro-cellulose, Gun-cotton, Collodion, Nitric acid, Sulfuric acid.

Nitro-cellulose wastes contain nitric acid, sulfuric acid and various other chemicals, including an extremely high content of sulfur. Neutralization is imperative whether the waste is treated biologically or discharged to a dilutant stream. Further addition of phosphorous in the amount of .2 mg/l is necessary to support biological treatment. The high nitrate content of nitro-cellulose waste allows it to be treated in a biological denitrifying process rather than conventional activated sludge. The advantages of the denitrification process are: (1) treatment is achieved with no artifical oxygen supply; (2) the nitrate content of the sewage is reduced; (3) the pH value of the sewage increases during treatment; (4) less excess sludge is produced. Close control must be maintained over the process since the high nitrate content gives the sludge a tendency to float. Care must also be taken in the design of the plant, since even the neutralized waste streams are sufficiently high in sulfates to cause corrosion difficulties, particularly in concrete pipes. (Lowry-Texas) W71-04499

TREATMENT OF PHOTOGRAPHIC LABORA-TORY WASTES AT NORTON AIR FORCE BASE, CALIFORNIA,

Montgomery Research, Inc., Pasadena, Calif. Paul V. Hennessy, Donald G. Rosenberg, and Raymond G. Zehnpfenning.

Proceedings, 22nd Industrial Waste Conference, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 740-751, July 1968. 1 fig, 7 tab.

Descriptors: *Industrial wastes, *Groundwater, Activated sludge, Trickling filters, Sewage treatment, Geology, Conductivity, Hydrogen ion concentration, California, Waste water treatment, Biological treatment.

Identifiers: *Cyanide, *Ferrocyanide, *Ferricyanide, Norton Air Force Base (Calif), San Bernardino (Calif), *Photographic wastes.

Norton Air Force Base disposes of sanitary and industrial wastes through the facilities of the City of San Bernardino which uses secondary biological processes in the treatment of its wastes. geological setting of this area is such that the waste water that leaves this area is used again by municipalities and agriculture, therefore, it is essential that minerals and toxic materials must be adequately treated or disposed of to prevent a buildup of these elements. Methods of disposal, regulation of discharge, the monitoring program, the nature of the waste streams, and the treatment of cyanide are discussed in relation to Norton Air Force Base. (Ellis-Teyas) W71-04500

FLYASH AS A FILTERING AID FOR DE-WATERING INDUSTRIAL WASTE SLUDGE.

Uniroyal, Inc., Mishawaka, Ind.

Proceedings, 22nd Industrial Waste Conference, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 429-440, July 1968. 7 fig.

Descriptors: *Dewatering, *Fly ash, *Filtration, *Sludge, *Industrial wastes, Sludge treatment, Sludge disposal, Hydrogen ion concentration, Chutes, Conveyance, Structures, Temperature, Waste water treatment, Indiana.

Identifiers: Sludge concentration, Vacuum filter, Filter drums, Compressed air.

Dewatering industrial waste plant sludge using flyash has proven successful at Uniroyal, Inc., U. S. Rubber plant located at Mishawaka, Indiana. In the process of dewatering the sludge, six major pieces of equipment are involved: (1) a filter drum that works on vacuum filtration; (2) a screw type conveyor to mix the sludge-flyash mixture and transport it to the filter drum; (3) a centrifuged blower is used to maintain the desired vacuum in the filter drum vacuum chambers; (4) filtrate pump; (5) a blower type air compressor that supplies air to the vacuum filter for filter cake removal; and (6) a cake collecting chute and conveyor. Field and lab studies considered: (1) the proper concentrations of flyash; (2) the effect of sludge temperature on the dewatering process; (3) the effect of pH of the sludge; (4) the effect of sludge solids concentration; and (5) the effect of various vacuum conditions for proper sludge dewatering. (Ellis-Texas) W71-04502

HYDRAULIC AND PROCESS ASPECTS OF REACTOR DESIGN-I, BASIC CONCEPTS IN STEADY-STATE ANALYSIS,

Rice Univ., Houston, Tex. J. C. McLellan, and A. W. Busch. Proceedings, 22nd Industrial Waste Conference, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 537-552, July 1968. 8 fig, 3 tab, 15 ref.

Descriptors: *Hydraulics, *Activated sludge, *Design, Biochemical oxygen demand, Organic wastes, Retention, Aeration, Waste water treat-

Identifiers: *Steady-state analysis, Substrate utilization, Mixed liquor, Suspended solids.

A method by which the poundage of microorgan-isms required to remove a total poundage of soluble organic waste in a given period of time and produce an effluent of a given substrate concentration is presented. The interaction of the flow rate and influent substrate concentration affects effluent quality in the activated sludge process. The effects of either of these factors may be negated by control of the MLSS poundage in the aerator up to the limiting MLSS concentration. One of the critical points in choosing an aerator volume is the ability to control the MLSS concentration. Once the reactor volume has been chosen, the MLSS concentration governs effluent quality. Hydraulic retention time is not a fundamental criterion of activated sludge process design because the apparent need for increased hydraulic detention time may be offset by increases in MLSS poundage. Subsequent papers in this series will extend the analysis to unsteady-state conditions. (Ellis-Texas)
W71-04503

Group 5D—Waste Treatment Processes

LIMITATIONS OF OXYGEN TRANSFER IN THE WARBURG APPARATUS,

Rice Univ., Houston, Tex.
J. O. Bryant, W. W. Akers, and A. W. Busch.
Proceedings, 22nd Industrial Waste Conference,
May 2, 3, 4, 1967, Purdue University, Vol LII, No
3, p 686-698, July 1968. 6 fig, 2 tab, 29 ref.

Descriptors: *Mass transfer, *Respiration, *Ox-Descriptors: "Mass transfer, 'Respiration, 'Oxygen, Pressure, Biochemistry, Waste water treatment, Degradation, Oxidation, Oxygen demand. Identifiers: *Warburg apparatus, *Oxygen transfer, Glutamic acid, Glucose, Oxygen uptake.

In order to show that oxygen transfer rates can limit the rate of biological reactions in the Warburg system, experiments were conducted to determine oxygen uptake progressions for the degradation of oxygen uptake progressions for the degradation of glutamic acid, glucose, sodium acetate, and pyruvic acid by mixed microbial populations at oxygen partial pressures of 0.21, 0.50, and 1.0 atmospheres in the Warburg respirometer. The limiting mechanism the Warburg respirometer. The limiting mechanism in oxygen uptake progressions obtained under these experimental conditions for plateau oxygen demands greater than 100 mg/l is the physical transfer of oxygen from the gas to the liquid phase. Oxygen limitation in the system may affect the study of biological oxidation by distorting apparent reaction stoichiometry and by yielding erroneous the measurements. Chilis Taxes rate measurements. (Ellis-Texas) W71-04504

CANNERY WASTE TREATMENT PART II.

TREATABILITY, San Jose State Coll., Calif. F. J. Agardy, R. G. Spicher, and G. T. Orlob. Proceedings, 22nd Industrial Waste Conference, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 699-705, July 1968. 1 fig, 2 tab.

Descriptors: *Waste treatment, *Canneries, Organic matter, *Biodegradation, *Organic wastes, Biochemical oxygen demand, Chemical oxygen demand, Toxicity, Waste water treatment.

Identifiers: Peach waste, Tomato waste, Carbonaceous, Biodegradation rate.

An analysis of dissolved versus suspended solids, volatile and inert SS, volatile and inert DS, volatile and inert TS, the disposition of BOD and COD, and biodegradation rate studies were conducted. The cannery waste of tomatoes and peaches were found to have a high percentage of organic matter in solu-tion. This distribution of organic matter favors the employment of biochemical treatment methods suitable for stabilization of dissolved organics as opposed to physical processes. There is a possibility that high concentrations of cannery wastes might result in a reduction of biodegradation rate due to a lack of required nutrients or presence of trace inhibitory agents. (Ellis-Texas) W71-04505

AQUA AMMONIA NEUTRALIZATION OF ACID EFFLUENT FROM A DEIONIZER, Carling Breweries Ltd., Waterloo (Ontario). W. R. Garvie, and D. E. Waite. Proceedings, 21st Industrial Waste Conference, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, p 650-655. 3 fig, 1 tab.

Descriptors: *Hydrogen ion concentration, *Neutralization, *Alkalinity, *Acidity, Nitrogen compounds, Mixing, Solubility, Ion exchange, Biocehmical oxygen demand, Automatic control, Chemical wastes, Waste water treatment, Ammonia compounds, Effluents.

Identifiers: *Caustic soda, *Aqua ammonia, Regeneration, Resin exhaustion, Deionizer.

Overall benefits of aqua ammonia are: (1) Reduced chemical costs based on equivalent weights; (2) Reduced chemical costs based on more efficient neutralization; (3) Improved automatic control yielding a more uniform effluent to the sewers; (4) Reduced suspended solids in the effluent as a result of increased solubility of ammonia salts; (5) Provision of a prime source of available nitrogen to the

activated sludge process of the sewage treatment plant. Problems associated with the use of ammonia nitrogen are primarily associated with fumes, corrosive effects, and danger of explosion. Proper ventilation, inspection, and maintenance are imperative. If properly designed and maintained, ammonia nitrogen neutralizing equipment can successfully alleviate most acid waste problems with good economic competitiveness. (Lowry-Tex-W71-04506

DECONTAMINATION OF CYANIDE WASTES BY METHODS OF CATALYTIC OXIDATION AND ADSORPTION,

Ruhr River Association, Essen (West Germany).

Wilhelm Bucksteeg.
Proceedings, 21st Industrial Waste Conference, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, p 688-695. 1 fig, 5 tab, 3 ref.

Descriptors: *Chemical wastes, *Adsorption, *Oxidation, *Catalyst, Sedimentation, Trickling filters, Biodegradation, Biological treatment, Waste water treatment.

Identifiers: *Cyanide wastes, *Low temperature coke, *Sewage sludge charcoal, Galvanic wastes, Toxic shock, Ceramic.

Low temperature coke made from soft brown coal shows surprising ability to adsorb and oxidize potassium cyanide and free cyanide. The cyanide is adsorbed onto the surfaces of the coke grains and part of it is oxidized to CO2, nitrogen, and water, while the rest is decomposed to carbon dioxide and ammonia. Experiments with low temperature coke and sewage sludge charcoal showed removals of cyanide in the 90 to 99% range. Filters made with low temperature coke have two distinct advantages to users. Manufacturers can often recycle water from which cyanides have been removed. This means considerable savings to manufacturing con-cerns. Also, waste water filtered to remove cyanides can then be treated biologically, and by incorporating an upper layer of coke and ceramic material with a conventional filler in a lower layer, then cyanide removal and biological treatment can be achieved in the same facility at great savings. (Lowry-Texas) W71-04507

THE TREATMENT OF FLUORIDE WASTES,

Corning Glass Works, N.Y. W. Zabban, and H. W. Jewett.

Proceedings, 22nd Industrial Waste Conference, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 706-716, July 1968. 8 fig, 7 ref.

Descriptors: *Waste water treatment, Sedimentation, Chemical precipitation, *Neutralization, Toxicity, Industrial wastes, Hydrogen ion concentration, Temperature, Ion exchange.
Identifiers: *Fluoride wastes, *Activated alumina, Sodium hydroxide, Bone char, Hydrofluoric acid

waste, Calcium hydroxide.

Hydrofluoric acid wastes mixed with abrasive and siliceous wastes have been treated satisfactorily at a number of plants by neutralization with calcium hydroxide and sedimentation in continuous clarification units at pH values of slightly over 11. Clarified effluents containing less than 20 mg/l of fluoride ion are produced. If the treated effluent is allowed to stand for several hours, post precipitation of fluoride salt will occur, thus increasing the concentration of fluoride in the effluent to within the solubility limits for calcium fluoride. Where required, additional fluoride removal may be obtained by passage of the fluoride waste through a bed of activated alumina regenerated with sulfuric acid, or through bone char regenerated with sodium hydroxide. (Ellis-Texas) W71-04508

INDUSTRIAL REUSE OF MUNICIPAL WASTE

Fuller Co., Tucson, Ariz.

C. F. Garland, and L. K. Cecil. 7th Industrial Water and Waste Conference, Texas Water Pollution Control Association, June 1 and 2, p IV-1-IV-10, 1967. 3 tab, 10 ref.

Descriptors: *Municipal wastes, *Industrial plants, Sludge disposal, Domestic wastes, Activated sludge, Ion exchange, Chemical reaction, Carbon adsorption, Filter, Lime, Activated carbon, Waste water treatment, *Water reuse, *Tertiary treat-

Identifiers: INFILCO, Recarbonator, Solids-contact stabilizer.

INFILCO initiated two pilot plant studies for tertiary treatment of the effluent from a 12 MGD activated sludge plant. One system is based on complete treatment of all water before withdrawal for reuse and includes the following: (1) a chemical treatment unit; (2) a sand filter; (3) a primary cation exchanger; (4) carbon adsorption columns; (5) a primary anion exchanger; (6) a secondary cation exchanger; and (7) a secondary anion exchanger. The other system involves a series of treatment operations which progressively upgrade water quality, and from which water may be drawn for specified uses as soon as individual use requirements are met. Units involved in this process include: (1) a lime treatment unit; (2) a recarbonator; (3) a solids-contact stabilizer; (4) a sand filter, and (5) a carbon contactor. The cost of the first process is around 40 cents/1000 gallons while the second system would cost around 42.5 cents/1000 gal. (Ellis-Texas) W71-04509

THE TAHOE PROCESS FOR NUTRIENT REMOVAL,

Cornell, Howland, Hayes, and Merryfield, Corvallis, Oreg. Russell L. Culp. 7th Industrial Water and Waste Conference, Texas

Water Pollution Control Association, p I-3 - I-25, June 1 and 2, 1967. 12 fig, 2 tab, 34 ref.

Descriptors: *Activated carbon, *Adsorption, *Filtration, *Lime, Sewage treatment, Tertiary treatment, Water purification, Phosphate, Nitrogen, Coagulation, Activated sludge, California, Waste water treatment.
Identifiers: *Lake

Tahoe, Recarbonation, Regeneration, Lime recalcining, Ammonia stripping, *Nutrient removal.

A 2 1/2 MGD water reclamation plant was placed into operation during the summer of 1965 at South Tahoe, California. The process which evolved from the operating experience of this original tertiary plant plus the information gained from this demonpriate puts the information game and the management of an expanded process capable of handling 7 1/2 MGD. The new process not only removes phosphates, nitrogen, and organics present in waste waters, but also provides for the recovery and reuse of chemicals employed in the process. All solid wastes are reduced to sterile ash by incineration. The total investment to provide tertiary treatment will be almost equal to that for providing secondary treatment at Tahoe. W71-04510

PRACTICAL AND TECHNICAL ASPECTS OF REUSING EFFLUENT FROM WASTE TREAT-MENT PLANTS, Eimco Corp., Salt Lake City, Utah. A. A. Kalinske.

7th Industrial Water and Waste Conference, Texas Water Pollution Control Association, June 1 and 2, 1967, p IV-35-IV-44. 11 ref.

Descriptors: *Water reuse, *Advanced waste treatment, *Tertiary treatment, Recharge, Phosphates, Nitrates, Biochemical oxygen demand, Ammonia, Chemical oxygen demand, Hardness, Detergents, Waste water treatment.
Identifiers: *Suspended solids.

Waste Treatment Processes—Group 5D

Reuse of waste water for domestic and industrial uses is technically and economically feasible and justified today. A progressive approach to waste treatment is discussed in view of possibly eliminat-ing some of our older methods of treatment if necessary. Removals of suspended solids, phosphates, and nitrogen from waste waters are discussed in light of a recent practical problem in-volving a pilot plant study of treating a trickling filter plant effluent for use as cooling and makeup water in a stream power plant. (Ellis-Texas) W71-04511

AN EVALUATION OF DIFFUSION MEM-BRANES FOR WASTE WATER REHABILITA-TION.

Dorr-Oliver, Inc., Stamford, Conn.
R. W. Okey, and R. A. Fiedler.
7th Industrial Water and Waste Conference, Texas Water Pollution Control Association, June 1 and 2, 1967, p IV-16-IV-34. 10 fig, 2 tab, 8 ref.

Descriptors: *Diffusion, *Membranes, *Filtration, Activated sludge, Waste water treatment, Phosphorous, Desalination, Biochemical oxygen demand, Activated sludge, Sludge treatment,

Identifiers: Suspended solids.

An analysis of the pertinent system theory, a series of experiments on a membrane system, and an economic analysis have been carried out. This experimental work indicated the use of a diffusion membrane system as an activated sludge phase separation device, a system study of the flux, velocity solids, and pressure interrelationship, and an analysis of the movement of phosphorus through a membrane augmented activated sludge facility. The study of system economics included inputs from the literature as well as the results of the work reported here. (Ellis-Texas) W71-04512

PHOSPHATE REMOVAL BY ACTIVATED SLUDGE, PART I: PILOT-SCALE EXPERIENCE,

Federal Water Pollution Control Administration. Ada, Okla.

C. P. Priesing.

7th Industrial Water and Waste Conference, Texas Water Pollution Control Association, June 1 and 2, 1967, p II-4 to II-5.

Descriptors: *Phosphates, *Activated sludge, Descriptors: "Priosphates, "Activated studge, Biochemical oxygen demand, Dissolved oxygen, Water pollution, Filtration, Texas, Oklahoma, Waste water treatment, Sludge treatment, Aeration.

Identifiers: *Phosphate removal.

Aeration jug studies were utilized to pilot research the range and limitations associated with application of the operational parameters considered significant to phosphate removal. Five municipal waste treatment plants at diverse locations were analyzed and tested for amenability to phosphate removal. These tests showed that diverse wastes and sludges can be adapted to phosphate removal by control of operational parameters in the activated sludge process. (Ellis-Texas) W71-04513

PHOSPHATE REMOVAL BY ACTIVATED SLUDGE, PART II: PLANT EXPERIENCE, Federal Water Pollution Control Administration,

Ada, Okla. J. L. Witherow

7th Industrial Water and Waste Conference, Texas Water Pollution Control Association, June 1 and 2, 1967, p II-6-II-7.

Descriptors: *Phosphates, *Activated sludge, Biochemical oxygen demand, Filtration, Tracers, Texas, Waste water treatment, Sludge treatment, Aeration.

Antonio (Tex), Iron-59. Identifiers: San *Phosphate removal.

A 24 hour profile of the Rilling Plant in San Antonio, Texas, established that phosphate removal followed a daily cycle. Aeration detention time and minimum solids detention time in the final clarifiers are important parameters in phosphate removal and depend on the hydraulic characteristics of the aeration basins and the final clarifiers. (Ellis-Tex-

W71-04514

UPTAKE OF SOLUBLE PHOSPHATE BY ACTIVATED SLUDGE: PARAMETERS OF IN-FLUENCE.

Maine Univ., Orono

Millard W. Hall, and Richard Engelbrecht. 7th Industrial Water and Waste Conference, Texas

Water Pollution Control Association, June 1 and 2, 1967, p II-8-II-27. 7 fig, 4 tab, 14 ref. United States Public Health Service Research Fellowship No 5-F1-WP21,616-03.

Descriptors: *Phosphate, *Activated sludge, *Dissolved oxygen, *Aeration, Hydrogen ion concentration, Chemical oxygen demand, Waste water treatment.

Identifiers: *Mixed liquor, Suspended solids, *Sub-

An assessment by laboratory experimentation of the influence of mixed liquor suspended solids concentration, substrate concentrations and dissolved oxygen concentration on the magnitude and rate of soluble phosphate reduction in activated sludge mixed liquor. Aeration on time was found to be an important parameter inasmuch as 90% reduction of the phosphate content was achieved in a 24 hour period but 50% of this was achieved in the first 6 hours. The MLSS concentration in the range employed by most activated sludge plants was not a significant factor in phosphate removal. Soluble phosphate uptake increased with increasing initial soluble substrate concentration. Soluble phosphate reduction is also dependent upon the DO concentration. (Ellis-Texas) W71-04515

ON PURIFICATION OF RADIOACTIVE WASTE WATER BY CONTACT PRECIPITATION. 4TH COMMUNICATION: EFFECT OF COMPLEX DETERGENTS, AND LIQUIDS, (IN GERMAN),

Zentralinstitut fuer Kernforschung, Rossendorf bei

Oresden (East Germany).
G. Sachse, and H. Schlenkrich.
Kernenergie, Vol 12, No 11, p 363-367, 1969. 3 fig, 5 tab, 8 ref.

Descriptors: *Waste water treatments, *Radioactive wastes, Detergents, Precipitable water, Separa-tion techniques, Waste disposal, Nuclear power-plants, Calcium carbonate, Water purification. Identifiers: Cerium-141, Strontium-90, Condensed phosphates, Dresden (Germany).

This part of the investigations of waste water was concerned with the effect of complex formers and detergents on contact precipitation and behavior of cerium-141 and strontium-90. It was demonstrated that oxalic, citric, and tartaric acids in concentra-tions between 100 and 150 mg/l, as well as the detergents and wash liquids up to concentrations from 75 to 100 mg/l, exert no detrimental influence on calcium carbonate precipitation. On the other hand, strong complex formers, such as condensed phosphates and EDTA, invariably and totally prevent contact precipitation and separation of radionuclides. The contact precipitation increased slightly the separation of Ce-141 and Sr-89. Contact precipitation should be used in purification of radioactive waste water of atomic energy plants. (Wilde-Wisconsin) W71-04521

TERTIARY TREATMENT OF COMBINED WASTE WATER,

Calgon Corp., Pittsburgh, Pa. Filtrasorb Dept.; and Cincinnati Univ., Ohio. Dept. of Civil Engineering. R. H. Zanitsch, and J. M. Morand.

Water and Wastes Engineering, Vol 7, No 9, p 58-60, 1970. 4 fig, 1 tab, 3 ref.

Descriptors: *Carbon, *Tertiary treatment, Industrial wastes, Domestic wastes, Activated carbon, Ohio, Adsorption, Organic matter, Suspended load, Biochemical oxygen demand, Color, Isotherms, Effluents, Microorganisms, Trickling filters, Spectrophotometry, Waste water treatment, California.

Identifiers: *Combined waste water, Cincinnati (Ohio), Pomona (Calif), Lake Tahoe (Calif), Organic dyes, Fluorescein.

The feasibility of removing refractory organic material and dyes from an activated sludge effluent using granular activated carbon was studied. A colorless effluent containing an average of 3 mg/l biochemical oxygen demand and 3 mg/l suspended solids was produced in the 61-day trial. Tertiary treatment with granular activated carbon has been demonstrated in a pilot scale at Pomona, California; a full-scale advanced waste treatment plant is in operation at Lake Tahoe, California. The source of waste water for each of these plants is basically of domestic origin, free of industrial contamination. At the Mill Creek Sewage Treatment Plant in Cincinnati, the influent is a combined industrialdomestic waste containing organic dyes, one of which is fluorescein. The green fluorescein color is soluble and, therefore, is not removed by primary treatment. In a preliminary test, an adsorption isotherm study was conducted on a grab sample; the isotherms demonstrated that the schildle the isotherms demonstrated that the soluble ganic carbon level of secondary effluent could be sganificantly reduced by adsorption on activated carbon. The carbon columns were used as both a filter and an adsorber. The fluorescein dye color bodies were effectively removed by adsorption on the granular carbon. (Jones-Wisconsin) W71-04533

BIOCHEMICAL OXIDATION OF HYDROCAR-BONS IN NATURAL WATERS,

Rhode Island Univ., Kingston. Dept. of Bacteriolo-

Chester W. Houston.

Chester W. Houston.

Available from NTIS as PB-197 585, \$3.00 in paper copy, \$0.95 in microfiche. Completion Report, Rhode Island Water Resources Center, (1971). 34 p. 4 tab, 15 fig, 10 ref. OWRR Project B-020-RI(1)

Descriptors: *Hydrocarbons, Kinetics, Cultures, *Oxidation, Temperature, Cytological studies, Productivity, *Fermentation.

Identifiers: *Heptane, Continuous Microbial oxidation, *Cell growth rates. Continuous

A study of the kinetics of microbial oxidation of A study of the kinetics of interobal oxidation of hydrocarbons was carried out using a one organism-pure hydrocarbon system (Pseudomonas aeruginosa-heptane). In batch culture, heptane supply is growth limiting at a cell concentration of 3 g/l on a dry basis. The cell concentration was increased to 8 g/l when heptane was volatilized in the influent air to increase interfacial area and mass transfer. Specific growth rate is increased by temperature more than can be accounted for by the effect of temperature alone on growth rate. The effect is attributed to the higher solubility of heptane at the higher temperature. Wash-out characteristic of continuous cultures on heptane differ from the theoretical and is explained on the basis of mass transfer limitations. Steady-states are possible at dilution rates higher than those predicted from batch cultures. Productivity was found to be 1.5 g/l/hr at D=0.26 with a heptane feed rate of 18 ml/hr. Limitation of magnesium or iron in the heptane limited cultures resulted in a marked increase in heptanoic acid production; heptane growth cells had a markedly higher lipid content than those grown on glucose. W71-04543

FEASIBILITY STUDY MANUAL - MINE WATER POLLUTION CONTROL DEMON-MINE

NUS Corp., Pittsburgh, Pa. Cyrus Wm. Rice Div.

Group 5D—Waste Treatment Processes

For primary bibliographic entry see Field 05G. W71-04545

REGARDING COLLECTED PAPERS AGRICULTURAL WASTE IN NITRATES WATERS.

Federal Water Quality Administration, San Fran-

For primary bibliographic entry see Field 05B. W71-04546

DESALINATION OF IRRIGATION RETURN

WATERS, Federal Water Quality Administration, Fresno, Calif. San Joaquin Project.

Bryan R. Sword.

Bryan R. Sword. In: Collected Papers Regarding Nitrates in Agricultural Waste Waters, Federal Water Quality Administration Water Pollution Control Research Series 13030 ELY, 12/69, p 81-105, December 1969. 25 p, 14 fig, 7 tab, 1 ref. FWQA Project 13030 ELY.

Descriptors: *Water pollution control, *Desalination, *Drainage water, Electrodialysis, California, Drainage effects, Reverse osmosis, Water pollution

sources, Drainage programs.
Identifiers: *Central Valley (Calif), *Groundwater

pollution control.

Experiments were conducted from June 1967 to November 1968, on the desalination of agricultural tile drainage waters near Firebaugh, California. The water used in these studies was collected by a system of tile drains servicing a 400-acre field. These waters, which have percolated through 5 to 9 feet of soil, contained a total dissolved solids (TDS) concentration of from 2,500 to 8,000 mg/liter. Desalination of San Joaquin Valley tile drainage water was found to be technically feasible. The initial reverse osmosis stack was able to achieve over 90% TDS removal; however, nitrate and boron removals averaged less than 27%. The electrodialysis unit had an average TDS removal of 23%. The sis unit had an average TDS removal of 23%. The cost of supplies and power for reverse osmosis (Stack II) was \$0.41 per thousand gallons of product. The same costs for electrodialysis came to \$0.15 per thousand gallons of product. (See also W71-04546) (Knapp-USGS)

BACTERIAL DENITRIFICATION OF AGRICULTURAL TILE DRAINAGE,

Federal Water Quality Administration, Fresno, Calif. San Joaquin Project; and Stanford Univ., Calif. Dept. of Environmental Engineering. Thomas A. Tamblyn, Perry L. McCarty, and Percy

In: Collected Papers Regarding Nitrates in Agricul-tural Waste Waters, Federal Water Quality Ad-ministration Water Pollution Control Research Series 13030 ELY, 12/69, p 107-121, December 1969. 15 p, 3 fig, 2 tab, 19 ref. FWQA Project 13030 ELY.

Descriptors: *Waste water treatment, *Water pollution control, *Denitrification, *Biodegradation, *Drainage water, California, Drainage programs, Anaerobic bacteria, Anaerobic conditions.

Identifiers: *Central Valley (California), *Bacterial denitrification.

Initial field studies in the Central Valley of California of bacterial denitrification of irrigation waste water in simulated deep ponds indicated that significant denitrification could take place in ponds with detention times as low as 5 days. Covered ponds consistently outperform the uncovered one. Large algal populations develop in uncovered ponds and the resultant high dissolved oxygen concentration inhibits denitrification. More influent is short-circuited through the uncovered pond because of wind mixing and temperature variations. Treatment in either anaerobic ponds or fil-ters will most likely cost between \$30 and \$60 per million gallons of waste treated. Agricultural tile drainage can be biologically treated and discharged to the San Francisco Bay System at less cost than that of any alternative plan. (See also W71-04546) (Knapp-USGS) W71-04553

ALGAL NUTRIENT RESPONSES IN AGRICUL-

TURAL WASTE WATER, Federal Water Quality Administration, Fresno, Calif.; and California State Dept. of Water Resources, Fresno.

James F. Arthur, Randall L. Brown, Bruce A. Butterfield, and Joel C. Goldman.

In: Collected Papers Regarding Nitrates in Agricul-tural Waste Waters, Federal Water Quality Ad-ministration Water Pollution Control Research Series 13030 ELY, 12/69, p 123-141, December 1969. 19 p, 8 fig, 1 tab, 12 ref. FWQA Project 13030 ELY.

Descriptors: *Algae, *Waste water treatment, *Water pollution control, *Denitrification, *Biodegradation, *Drainage water, California, Drainage programs, Anaerobic bacteria, Anerobic conditions, Lagoons. Identifiers: *Central Valley (California), *Bacteri-

al denitrification.

Algal assimilation of nutrients into cellular material with subsequent removal from the growth medium is a feasible process to remove nitrates from irrigation waste water. The efficiency of the proposed system is greatly enhanced if as many variables as possible are optimized, leaving only nitrogen the limiting nutrient. Orthophosphate additions of 2.0-3.0 mg/liter P are required the year round to remove 20.0 mg/liter nitrate-nitrogen from the growth medium. Iron and carbon also have been found to be limiting algal growth and nitrogen assimilation during part of the year. (See also W71-04546) (Knapp-USGS) W71-04554

THE EFFECTS OF NITROGEN REMOVAL ON THE ALGAL GROWTH POTENTIAL OF SAN JOAQUIN VALLEY AGRICULTURAL TILE DRAINAGE EFFLUENTS,
California State Dept. of Water Resources, Fresno;

and Federal Water Quality Administration,

Alameda, Calif.
Randall L. Brown, Richard C. Bain, Jr., and Milton G Tunzi

In: Collected Papers Regarding Nitrates in Agricultural Waste Waters, Federal Water Quality Administration Water Pollution Control Research Series 13030 ELY, 12/69, p 143-155, December 1969. 13 p, 4 fig, 4 tab, 3 ref. FWQA Project 13030

Descriptors: *Algae, *Waste water treatment, *Water pollution control, *Denitrification, *Biodegradation, *Drainage water, California, Drainage programs, Anaerobic bacteria, Anaerobic conditions, Lagoons.

Identifiers: *Central Valley (California), *Bacterial denitrification.

Laboratory culture experiments were made to determine the effectiveness of the two biological processes under investigation, algal stripping and bacterial denitrification, for removing the algal growth potential of the tile drainage water when added to potential receiving waters in the Sacra-mento-San Joaquin Delta. Algal growth potential tests in two different laboratories indicate that nitrate-rich agricultural drainage, when mixed with San Joaquin River Delta water, stimulates algal growth. Selective removal of nitrate-nitrogen by anaerobic denitrification or removal of nutrients by algal cells grown in shallow ponds yielded comparable bioassay results. Eutrophication due to agricultural waste waters can be controlled by treatment. (See also W71-04546) (Knapp-USGS) W71-04555

GROWN HARVESTING OF ALGAE AGRICULTURAL WASTE WATERS,

California State Dept. of Water Resources, Fresno; and Bureau of Reclamation, Fresno, Calif. Bruce A. Butterfield, and James R. Jones.

In: Collected Papers Regarding Nitrates in Agricultural Waste Waters, Federal Water Quality Administration Water Pollution Control Research Series 13030 ELY, 12/69, p 157-163, December 1969. 7 p, 1 tab. FWQA Project 13030 ELY.

Descriptors: *Algae, *Waste water treatment, *Water pollution control, *Denitrification, *Biodegradation, *Drainage water, California, Drainage programs, Anaerobic bacteria, Anaerobic conditions, Lagoons.
Identifiers: *Algae harvesting, *Central Valley

(Calif.).

Through laboratory and field testing of algae harvesting methods for denitrification, it was shown that effective concentration can be accomplished using the flocculation-sedimentation process to remove 90-95 percent of the suspended solids from algae-laden agricultural waste water. Dewatering and drying can be accomplished but the efficiencies of the units tested were low. The need to recirculate the water would increase the overall cost; however, it is believed better results will be achieved in larger capacity units. (See also W71-04546) (Knapp-USGS) W71-04556

COMBINED NUTRIENT REMOVAL TRANSPORT SYSTEM FOR TILE DRAINAGE FROM THE SAN JOAQUIN VALLEY,

California State Dept. of Water Resources, Fresno; and Federal Water Quality Administration, Fresno, Calif.; and California Univ., Berkeley. Dept. of Sanitary Engineering and Public Health

Joel C. Goldman, James F. Arthur, William J. Oswald, and Louis A. Beck.

In: Collected Papers Regarding Nitrates in Agricultural Waste Waters, Federal Water Quality Administration Water Pollution Control Research Series 13030 ELY, 12/69, p 165-186, December 1969, 22 p, 4 fig, 1 tab, append. FWQA Project 13030 ELY.

Descriptors: *Algae, *Waste water treatment, *Water pollution control, *Denitrification, *Biodegradation, *Drainage water, California, Drainage programs, Anaerobic bacteria, Anaerobic conditions, Lagoons.
Identifiers: *Algae harvesting, *Central Valley (Calif.).

Current plans call for treatment of agricultural waste water for nutrient (nitrogen) removal from the proposed San Luis and Master Drains prior to discharge into the Bay-Delta Area. Of the several treatment processes being investigated, the algae stripping process is estimated to require between 6,000 and 12,000 acres of land to accomplish this task. Because every body of water is a potential algal growth system, there are several alternatives which will greatly reduce the total cost of treatment and perhaps improve the overall efficiency of nutrient removal. In-Line Treatment using the drain and the drainage reservoirs for algae growth may be an economical and practical method for nutrient removal. Because Kesterson Reservoir is an integral part of the proposed drainage system and contains the required area needed for treatment by algae stripping, it seems logical to use it as a dual-purpose treatment and storage reservoir. Kesterson Reservoir, if modified as suggested, has the potential to provide nitrogen removals in excess of 90%. (See also W71-04546) (Knapp-USGS) W71-04557

CONCEPTUAL ENGINEERING REPORT -KINGMAN LAKE PROJECT. Weston (Roy F.) Inc., West Chester, Pa.

available from GPO Sup Doc 167.13/4:11023FIX, \$1.25; microfiche from NTIS as PB-197 598, \$0.95. Water Pollution Control Research Series 11023 FIX 08/70, August 1970. 149 p, 23 tab, 7 fig, 25 ref, 5 append.

Descriptors: *Activated carbon, Adsorption, Combined sewers, District of Columbia, *Overflows Pollution abatement, Precipitation (Rainfall), Recreation facilities, *Water storage, *Water reclamation, *Waste water treatment, *Treatment plants, Cost benefits, Costs, Cost allocation, Feasibility studies, Project feasibility.
Identifiers: *Combined sewers.

This conceptual engineering study concerns the reclamation of combined sewer overflows and utilization of the reclaimed waters in a major wateroriented recreational facility for the District of Columbia. The investigation encompasses a comprehensive solution of environmental problems by proposing multi-use objectives and facilities. Principal objectives of the project included: (1) evalua-tion of rainfall runoff relationships for sizing of storage and treatment plant capacities; (2) confirmation of treatment feasibility using filtration and an activated carbon process; and (3) development of sufficient data for preliminary design purposes. Laboratory studies not only demonstrated process feasibility, but showed the need for including flocculation and sedimentation for removal of minute particles, together with chlorine and iodine addition for maximum disinfection. The recommended storage/treatment plant provides for a 175 million gallon storage basin, a 50 million-gallon-per-day reclamation facility and two 46-acre swimming and boating lakes. Cost effectiveness (Cost/Benefit Ratio) of the project, as envisioned, has been indicated to be 1.6 at an estimated total project cost of \$45,200,000, and an estimated annual operating cost of \$1,777,000. Implementation of the proposed plan would not only provide a least-cost alternative over single-purpose projects to attain identical objectives, but would also reduce the an-nual pollution now discharged by the Northeast Boundary Trunk Sewer by approximately 99 percent. W71-04616

A STUDY OF FLOW REDUCTION AND TREAT-MENT OF HOUSEHOLDS, WASTE WATER FROM

General Dynamics Corp., Groton, Conn. Electric Boat Div.

J. R. Bailey, R. J. Benoit, J. M. Robb, and H. Wallman.

Copy available from GPO Sup Doc as I67.13/4 11050FKE, \$1.25; microfiche from NTIS as PB-197 599, \$0.95. Water Pollution Control Research Series, 11050 FKE, Dec 1967. 154 p, 18 fig, 23 tab, 163 ref. FWQA Program 11050 FKE.

Descriptors: *Water conservation, *Water demand, *Water pollution, *Water resources,
*Water storage, Water utilization, Water consumption, Water loss, Waste disposal, Domestic water, Pumps, Pipes, Water reuse, Water quality, Flow, Sewage disposal, Anaerobic, Aerobic, Municipal wastes, Waste water treatment.

Identifiers: *Recycle, *Urinals, *Water saving faucets, Water saving showerheads, Individual treatment systems, Liljendahl vacumm system.

The literature on household water quantity and quality requirements was reviewed, an average water use pattern postulated, and the amount of water used in various household functions was estimated. Comparisons of different water saving devices were made on a cost basis. Water quality is considered from three points of view: health, aesthetics, and engineering suitability. The future water demands may necessitate very strict disposal requirements and multiple water quality levels although the present standards do not tend to allow the use of several levels of water quality such as using laundering effluent for toilet flushing. Waste disposal problems of homes not connected to central sewerage systems were discussed. Septic tanks, change of phase processes, membrane processes, electrolytic processes, and other processes were

evaluated, mainly on a cost basis. Most of the methods considered do not appear to be suitable for individual households at this time but with changes in economic factors and technical improvements some of these methods may be attractive for future use. A survey of homeowners, architects-engineers, plumbers and plumbing equipment manufacturers was conducted to obtain representative reactions to methods used to control water quantity and quality and waste water treatment processes. It was found through these surveys that opinions formed from the literature survey not contrary to popular practices and beliefs. (Ellis-Texas) W71-04617

A NEW DEVICE FOR WASTE WATER TREAT-MENT SLUDGE CONCENTRATION.

Smith and Loveless, Lenexa, Kans Brian L. Goodman, and Robert B. Higgins. Water and Wastes Engineering, p 30-32, August 1970. 3 fig.

Descriptors: *Waste water treatment, *Sludge treatment, Activated sludge, Anaerobic digestion,

Dewatering.
Identifiers: *Sludge concentrator, Smith and Loveless (Lenexa, Kans).

Research pertinent to dehydration of solids yielded a new waste water treatment employing the S and L Sludge Concentrator. This device utilizes gravity and pressure dewatering to increase the content of solids of sludges prior to their disposal. The concentrator includes a feed pump, polymer system, sludge thickener, and a two-stage dewatering unit. The equipment can be utilized in a variety of waste water treatment processes, such as activated sludge, sludge drying beds, and anaerobic digestion. The cost for chemicals have been in the range of \$5 to \$15 per ton of dry solids; the cost for electric current is about 16 cents per hour of operation. (Wilde-Wisconsin) W71-04622

ECONOMICS OF TREATING SEWAGE AND

TRADE WASTES, Babtie, Shaw and Morton, Glasgow (Scotland).

R. M. Bradley. Effluent and Water Treatment Journal, p 526-530, 1970. 1 fig, 4 tab, 19 ref.

Descriptors: *Sewage treatment, *Sewage effluents, Population, Oxidation lagoons, Filtering systems, Cost comparisons, Economic feasibility, Industrial wastes, Municipal wastes.

Identifiers: *Packaged treatment plants, Plastic media filters, England, Small populations.

Both capital and operating costs of sewage treatment are analysed with the conclusion that some unconventional types of sewage treatment (packaged treatment plants) serving populations less than 1000 are economical. Comparative costs of treatment by biological filtration, oxidation ditch, and packaged plants are given. On-site industrial sewage plants are more economically operated than those of equivalent capacity for municipal sewage works, according to cost breakdowns. Although unconventional types of sewage treatment are associated with industrial wastes, they would be feasible for municipal waste processing. Recent operational results indicate that oxidation ditches produce a consistently satisfactory effluent although operational costs are higher than for conventional works but the more reliable effluent quality at such low population cost is compensatory; especially when debt charges are considered, the advantage of both oxidation ditches and packaged plants becomes even more attractive. High-rate biological filters using plastic media have their bigger impact for on-site industrial waste treatment and for relief of overloaded existing systems and reduction in land area. Data shows that industrial treatment plant construction is 50% of equivalent municipal sewage works. (Auen-Wisconsin) W71-04623

IN BIOLOGICAL SEWAGE-TREATMENT PROCESSES--I. A SURVEY OF THE PROTOZOAN FAUNA OF BRITISH PER-COLATING FILTERS AND ACTIVATED-SLUDGE PLANTS,

Water Pollution Research Lab., Stevenage (En-

gland). C. R. Curds, and A. Cockburn. Water Research, Vol 4, p 225-236, 1970. 3 fig, 2 tab. 12 ref.

Descriptors: *Activated sludge, *Waste treatment, *Protozoa, Filters, Industrial wastes.

Identifiers: *Ciliated protozoa, *Percolating filters. England, Scotland, Ciliates, Flagellates, Amoeba.

Microscopic examination of effluent from percolating filters and mixed liquor from activated-sludge plants revealed a predominant presence of ciliated protozoa and occasional occurrence of flagellated protozoa and amoebae. A complete list of species with their abundance and frequency of occurrence is included. Effluents of high quality, delivered by activated-sludge plants, contained a large variety and numbers of ciliated protozoa. Low quality turbid effluents of other activated-sludge plants were free from ciliates of contained only small numbers of a few species. The study failed to disclose any particular component of industrial effluents that is responsible for suppression of protozoan popula-tion. (See also W71-04628) (Wilde-Wisconsin) W71-04627

PROTOZOA IN BIOLOGICAL SEWAGE-TREATMENT PROCESSES--II. PROTOZOA AS INDICATORS IN THE ACTIVATED-SLUDGE PROCESS

Water Pollution Research Lab., Stevenage (En-

yaland). C. R. Curds, and A. Cockburn. Water Research, Vol 4, p 237-249, 1970. 4 fig, 4 tab, 14 ref.

Descriptors: *Sewage treatment, *Activated sludge, *Sludge digestion, Protozoa, Biochemical oxygen demand, Effluents, Indicators, Measurement.

Identifiers: *Ciliate protozoa, Sludge loads, Holotrichs, Peritrichs, Hypotrichs.

Activated sludges with loading below 0.3 BOD/g mixed liquor suspended solids per day contained the largest number of holotrichs, peritrichs, and hypotrichs, nearly equally distributed. However, the structure of protozoan communities in activated sludges appeared to be influenced by the BOD of the effluent. In turn, a correlation was established between the average effluent quality within the ranges of 0-10, 11-20, 21-30, and -30 mg/l and the taxonomic contents of the sludge. An application of the relationship to other sites proved to be correct in 83% of cases. (See also W71-04627) (Wilde-Wisconsin) W71-04628

AND STUDY OF NITRIFICATION

DENITRIFICATION, Envirogenics Co., El Monte, Calif. Byron J. Mechalas, Paul H. Allen, III, and Walter W. Matyskiela.

Copy available from GPO Sup 167.13/4:17010 DRD 07/70, \$1.00; microfiche from NTIS as PB-197 658, \$0.95. Water Pollution Series 17010 DRO 07/70, July Control Research Series 17010 DRO 07/70, July 1970. 90 p, 13 tab, 37 fig, 8 ref. FWQA Program No 17010 DRD.

*Denitrification, *Mathematical Descriptors: models, *Nitrates, *Nitrification, Aerobic conditions, Chemical oxygen demand, Evaluation, Laboratory tests, Nutrients, Organic loadings, Oxygen requirements, *Waste water treatment, ary treatment, Temperature, Biological treatment,

Identifiers: Residence time, Limiting substrate.

A program to incorporate biological denitrification into a waste water treatment system was un-

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dertaken with the objective of developing a process that depends exclusively on the carbon compounds contained in the waste water to supply metabolic energy to the microflora. In the experimental program the incoming nitrogenous material was oxidized to nitrate in an aerobic phase and reduced to nitrogen gas in an anaerobic phase. Conditions for developing a nitrifying microflora were investigated using a primary waste water effluent as feed. Flows into the system were varied to give a range of residence times. Anaerobic batch experiments were carried out to determine if stored reserves could support denitrification. Under appropriate conditions almost 100% of the nitrates could be reduced. The effluent from the aerobic unit served as the feed for the anaerobic process. At appropriate intervals this situation was reversed by switching the airflows and feed sources. Over 95% of the waste water nitrogen in waste water was removed. Nitrate-nitrogen removal rates ranged from 0.600 to 1.00 mg/hr/g MLVS. A mathematical model was developed which described the response to cycled aerobic-anaerobic operation.
The alternating cycle approach was shown to be an effective method for removing nitrogen from waste water. (Mechalas-Aerojet) W71-04667

COMBINED SEWER TEMPORARY UN-DERWATER STORAGE FACILITY. Melpar, Falls Church, Va.

Copy available from GPO Sup Doc as I67.13/4:11022 DPP 10/70, \$1.75; microfiche from NTIS as PB-197 669, \$0.95. Water Pollution Control Research Series 11022 DPP 10/70, October 1970. 75 p, 12 tab, 16 fig, 2 ref. FWQA Program 11022 DPP.

Descriptors: Storage, *Overflow, *Storm runoff, *Storage tanks, Sewers, Interception, Drainage, *Pumped storage, Costs, *Pumping plants, Maryland

Identifiers: *Combined sewers, Cambridge (Md), Choptank River, *Underwater storage.

A pilot plant underwater storage facility was designed, constructed, operated and evaluated as a method of temporarily storing storm overflow from the combined sewer of the Choptank Avenue drainage basin, Cambridge, Maryland. Combined sewage in excess of the sewer capacity, which would normally be discharged directly into the Choptank River, was intercepted and pumped into a nominal 200,000 gallon flexible underwater storage container located 1300 feet offshore. The stored overflow was later returned from the tank at a rate which could be accommodated by the intercepting sewer and treatment plant. The facility was tested with overflow both from four naturally occurring rainfalls and using fresh water simulation. The overflow samples were analyzed in a field laboratory for the following characteristics: pH, suspended solids, volatile suspended solids, settleable solids, 5 day biochemical oxygen demand, and chemical oxygen demand. The pilot plant facility was capable of collecting 96 percent of the average annual overflow from the drainage basin at a cost of less than \$1.85 per thousand gallons. The facility could prevent the annual discharge of 7,136 pounds BOD into the Choptank River. Underwater storage facilities could be used effectively for a number of combined sewer areas. Site selection, however, has been proven to be a critical factor. Care must be exercised to prevent public disturbance, and factors such as land use, tidal conditions, or the types of storms, must also be considered. (Meloy-Melpar) W71-04668

REVERSE OSMOSIS RENOVATION OF MUNICIPAL WASTE WATER,

Aerojet-General Corporation, El Monte, Calif. Environmental Systems Div.

Copy available from GPO Sup Doc as I67.13/4:17040 EFQ 12/69, \$1.50; microfiche

from NTIS as PB-197 659, \$0.95. Water Pollution Control Research Series ORD-17040 EFQ 12/69, 1969. 160 p, 12 tab, 107 fig. FWQA Program 17040 EFQ. Contract No 14-12-184.

Descriptors: *Reverse osmosis, *Sewage treatment, Tertiary treatment, Computer models, *Membrane processes, Demineralization, *Osmosis, *Waste water treatment, Municipal water, Solid wastes, Organic wastes, Costs. Identifiers: Process models, *Municipal waste water, Solids removal, Organics removal.

A fifteen-month laboratory program has shown that all grades of municipal waste water may be significantly improved by the reverse osmosis process. Comparisons are provided on the behavior and response of the reverse osmosis process to carbontreated secondary sewage, alum-treated secondary sewage, secondary sewage, primary settled sewage, raw sewage, and digester supernatant. High removals of dissolved minerals, organic substances, and suspended matter have all been achieved in the same treatment. The effects of a flocculant, dispersant, chelating agent, enzyme, and acid on reducing product water flux decline are compared. The relative effects of reverse osmosis test-cell geometry on solids deposition and membrane performance are presented. A phenomenological model is postulated describing the role of undissolved solids and organic substances in producing product water flux decline and the subsequent maintenance of constant product water fluxes. A computer model of the reverse osmosis process, compatible with the executive program written by the Federal Water Quality Administration, has been developed to provide an accurate and rapid method of determining the design and cost of reverse osmosis facilities.

APPLICATION OF HYPERFILTRATION TO TREATMENT OF MUNICIPAL SEWAGE EFFILIENTS.

(Feuerstein-Aerojet-General)

W71-04669

Oak Ridge National Lab., Tenn. Water Research Program. Kurt A. Kraus.

Copy available from GPO Sup Doc as 167.13/4:17030 EOH 01/70, \$0.70; microfiche from NTIS as PB-197 671, \$0.95. Water Pollution Control Research Series 17030 EOH 01/70, January 1970. 71 p. FWQA Program 17030 EOH.

Descriptors: Waste water treatment, *Filtration, *Membranes, Membrane processes, Effluents, Municipal wastes, Sewage effluents, *Sewage treatment, *Electrolytes, Ion exchange.
Identifiers: *Hyperfiltration, Membrane additives.

A large number of membranes dynamically formed from polyelectrolytes on fine-grained (ca. 0.5 micron) supports or filters were tested for application in hyperfiltration of effluents from the primary and secondary stages of a municipal sewage treatment plant. Since results with primary effluents were not significantly different from those with secondary, most of the later studies were limited to primary effluents. The dynamic membranes were principally examined for salt rejection, organic rejection, flux, and flux decline with time. Cationexchange membranes formed from anionic polyelectrolytes were generally superior to anion exchange membranes from polycations. Mem-branes formed from (unidentified) sewage constituents, while rejecting salts and organic materials, seemed inferior to separately formed dynamic cation-exchange-active membranes. In earlier studies, membrane additives were continuously supplied to the feeds. In later runs, which extended to several weeks operation at the sewage plant, such continuous addition did not seem required, at least for some of the more promising membrane additives tested, such as those formed from homogenized Dowex-50, homogenized Sephadex, and for a dual-layer membrane composed of hydrous zirconium oxide and polyacrylic acid. With these membranes, upward of 50% salt rejection was frequently found, together with higher alkaline earth and organic rejections at initial fluxes of 100 gfd and higher. Salt rejection in excess of 50% at fluxes in excess of 50 gfd were found in 60% of the cases after 20 hours operation. At high circulation velocities (larger than 20 ft/sec), flux decline was usually modest, and fluxes in excess of 50 gfd were often observed after two weeks' operation. W71-04671

TOTAL WATER USE.
Santee County Water District, Calif.

Project construction was jointly financed by the Santee County Water District and the Federal Water Pollution Control Administration, Dept. of the Interior. Santee County Water District, 1968. 16 p, 34 fig.

Descriptors: *Reclaimed water, *Water reuse, *Sewage treatment, *Waste water treatment, *Water conservation, *Water costs, Water shortage, Recreation, Oxidation lagoons, Municipal wastes, Water resources development, California.

Identifiers: *Santee County Water District, Zimpro sludge disposal process.

The recently constructed \$2,223,944 waste water reclamation plant of the Santee County Water District is recognized as being the most advanced facility of its kind in the world. The plant, serving only 14,500 persons, was built in lieu of joining with other nearby communities in forming a metropolitan sewer system designed for disposal of waste water into the Pacific Ocean. The primary reason for the adoption of a water reclamation system was the extremely high cost of municipal water which is presently imported from the Colorado River, more than 300 miles. The facility, completed in January 1968, consists of a raw sewage pump station, a 3.2-mile long sewage force main, an activated sludge treatment plant complete with sludge disposal facilities plus an oxidation pond, an effluent pump station, and a 1.9-mile long effluent distribution force main, all of which are an integral part of the existing recreational lake and water reclamation facilities. The raw sewage is pumped up Sycamore Canyon for processing in the new treatment plant. The effluent flows back down the canyon through an oxidation pond and spreading basins, and thence is filtered through natural underground aquifers into the recreational lake system from which effluent for distribution is pumped. The reclaimed water is used for recreational, agricultural and industrial purposes. Sludge treatment and disposal is accomplished by the wet air oxidation (Zimpro) process. The entire reclamation system is described and photographs and diagramatic sketches are included. (Poertner) W71-04680

CHARACTERIZATION, TREATMENT, AND DISPOSAL OF URBAN STORMWATER,

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

S. R. Weighel, R. R. Weigher, A. G. Christianson

S. R. Weibel, R. B. Weidner, A. G. Christianson, and R. J. Anderson.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 329-343. 1 fig, 6 tab, 29 ref.

Descriptors: *Storm runoff, *Precipitation, *Chlorinated hydrocarbon pesticides, Nitrogen, Phosphorous, Chlorides, Ammonia, *Coliforms, Bioassay, Chlorination, Biochemical oxygen demand, Chemical oxygen demand, Ohio, Waste water treatment, Water pollution control.

Identifiers: Surface wash, Fecal streptococcus, *Fecal coliforms, Thresholds, Suspended solids, Volatile suspended solids, Cincinnati (Ohio).

Increasing demand for water supplies, and public demand for pollution abatement has led to studies of the part played by precipitation and stormwater runoff. Inorganic nitrogen and hydrolyzable phosphate concentrations in rainwater were found to be .69 mg/l and 0.24 mg/l respectively: both ex-

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ceed Sawyer's threshold level for algal bloom. In addition, several different chlorinated organic hydrocarbon pesticides have been isolated and identified in rainfall at Cincinnati. Several water quality parameters of stormwater runoff were also investigated. Coliform densities greater than 2900/100 ml were found in 90% of the samples tested, high above the 1000/.100 ml standard applied for recreational water. Stormwater runoff also contains a high level of suspended solids, many of which are not amenable to removal by sedimentation. During runoff, stormwater runoff constituent discharge rates, expressed as percentage of average raw sewage constituent production rates at a population density of 9 persons/acre are: suspended solids; 2400%, COD;520%, BOD, 110% total hydrolyzable phosphate, 70%; and total nitrogen, 200%. From this analysis it is obvious that although stormwater runoff must contribute to water supplies in the future, it will require extensive treatment before it is fit for use as a potable water source. (Ellis-Texas) W71-04687

DETERMINATION OF ACTIVATED SLUDGE ACTIVITY-A POSSIBILITY OF CONTROLLING ACTIVATED SLUDGE PLANTS,

Ruhrverband, Essen (West Germany).

Wilheim Bucksteeg.
Proceedings of the Third International Conference on Water Pollution Research, Munich, German, 1966, p 83-94. 7 fig, 4 ref.

Descriptors: *Colorimetry, *Biodegradation, *In-Descriptors: *Colorimetry, *Biodegradation, *Indicator, Efficiency, Purification, Reduction, Biochemical oxygen demand, Activated sludge, *Sludge treatment, Waste water treatment. Identifiers: 2-3-5-Triphenyletrazolium chlordie, Extinction, Red formzaone, Damping intensity, Empirical, Mixed liquor, KMnO4demand.

An activated sludge process can be regulated solely on the basis of organic load and sludge activity. In this way, sludge concentration, expressed as the activity can be adjusted for maximum efficiency during either maximum load, or the 24 hour average load. The activity of dehydrogenases of the activated sludge responds so fast that a relationship between the activity and the loading can be established over as short as a two hour period. Since activity, Y, is determined by the dry sludge mass, x, and the organic loading, and there is a direct relation between Y and the purification effect, a, then the purification efficiency per unit volume is obtained by multiplying x by a. Therefore, because of the inter-relations, a, can be obtained when both x and y are known. Careful monitoring of x versus y and the sludge volume index allows operators to quickly determine what the condition of the sludge inside the tank is, and hence an operator can prevent failure by spotting slugs of toxic material which may be entering the process. (See also W71-04689 and W71-04690) (Lowry-W71-04688

DISCUSSION OF 'DETERMINATION OF AC-TIVATED SLUDGE ACTIVITY-A POSSIBILITY OF CONTROLLING ACTIVATED SLUDGE PLANTS,

Prague (C-Hydraulic Research zechoslovakia).

Milos Effenberger.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, p 94-97. 2 fig, 1 tab, 6 ref.

Descriptors: *Pilot plant, *Incubation, Activated sludge, Dissolved oxygen, Biochemical oxygen demand, *Sludge treatment, Waste water treatment. Identifiers: TTC, Dehydrogenase, Total activity, Specific activity, HURD, INKA, Triphenyl formazone, Aeration tank, Mixed liquor.

A difference in the level of turbulence will cause a difference in the level of biological activity in an activated sludge tank. However, measurements must be taken at the temperature at which the aeration tank is operating. If a different temperature is used to incubate the samples then results cannot be considered accurate. Lenhard, Nourse, and Schwartz recommend adjusting the pH of the solution during the standard test but this would cause the conditions to deviate from actual aeration tank conditions. Enzymic activity depends on the fact that the enzyme proteins are polyvalent dipolar ions which can exist in a number of forms depending upon the pH value of the substrate. Some of these forms are more active than others, resulting in considerable experimental error. Biological population changes in response to changes in the organic loading. Generally lower loads were characterized by protozoal sludge, while higher levels of loading resulted in bulking or filamentous sludge. A pilot plant activated sludge unit was operated in order to establish the relationship between total dehydrogenase activity and oxidation-reduction potential. The samples were kept at the temperature of the mixed liquor in the aeration tank. Dissolved oxygen content varied between 1 and 2 mg/l. Increasing dehydrogenase activity resulted in decreased oxidation reduction potential in the mixed liquor. However, the gradient of the line expressing the relationship of the two values was given by the technical and technological conditions of the activated sludge process. (See also W71-04688) (Lowry-Texas) W71-04689

DISCUSSION OF 'DETERMINATION OF AC-TIVATED SLUDGE ACTIVITY-A POSSIBILITY CONTROLLING ACTIVATED SLUDGE

PLANTS', Research Inst. for Water Resources Development, Budapest (Hungary). P. Farkas.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 98-102. 2 fig, 2 tab.

Descriptors: *Biodegradation, *Incubation, Diffusion, Bacteria, Metabolism, Biochemical oxygen demand, Activated sludge, *Sludge treatment,

Waste water treatment.
Identifiers: TTC, Formazone, *Endogenous respiration, Staining, Zoogloeal, MLSS, Biological

The TTC method for determining the 'activated sludge activity' reveals several different factors pertinent to the operation of an activated sludge plant. First of all, the TTC method can be used to determine the biological degradability of a particular substrate. The substrate activity, Y, depends on the organic loading. The increase in activity of a sludge in the endogenous respiration stage characterizes the activity of the substrate that was added. From these conclusions, it is obvious that the concentration of the active mass, Ma, if well estimated, may offer a far better design base that the conventional MLSS. Secondly, the TTC method was used to determine the accessability of oxygen to all parts of the sludge. TTC in the presence of oxygen is not reduced, so addition of TTC to a sludge blanket will result in stained sections only where the oxygen is not able to reach. This provides useful information concerning power levels and mixing intensity. Finally, TTC can be used to check the effluent quality of treatment plants. Overloading of an activated sludge installation results in dispersed growth of bacteria and poor settling characteristics. When incubated with TTC, poor quality effluents exhibit a purple color, the intensity of which is directly related to the number of free-swimming bacteria. (See also W71-04688) (Lowry-Texas) W71-04690

NONIONIC DETERGENTS AND RELATED SUBSTANCES IN BRITISH WATERS,

Ministry of Technology, London (England). Lab. of Government Chemist.

Stella J. Patterson, K. B. E. Tucker, and C. C.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 103-116. 2 fig, 4 tab, 10 ref.

Descriptors: *Degradation, *Detergents, *Foaming, Chromatography, Chemical analysis, Sewage. Effluents, Industrial wastes, Waste water treatment, Biodegradation, Aromatic compounds, Linear alkylate sulfonate.

Identifiers: *Polyglycols, *Nonionic detergents, *Anionic detergents, Aire River, Calder River, Synergism, Alkyl phenol-9-ethylene oxide.

Thin layer chromatographic techniques were developed to analyze river water for the presence of nonionic and anionic detergents and also polyglycols. Chromatographic techniques were used since none of the available chemical processes had the sensitivity required. It was found that 'hard' nonionic material and polyglycols degrade very slowly, and much residual concentration is present even after considerable time has passed. 'Soft' nonionic materials, on the other hand, degrade very rapidly and present little problem. The majority of rivers analyzed contained .01 mg/l or less of nonionic detergents while 3 rivers serving highly industrialized areas contained between .1 and .25 mg/l. Anionic detergents ranged from .1 to 1.8 mg/l with an average of .4 mg/l. In view of the synergistic effects which such detergents are known to possess, suitable combinations of detergents of this level can, and in fact do cause serious foaming problems. (See also W71-04692 thru W71-04694) (Ellis-Tex-

W71-04691

DISCUSSION OF 'NONIONIC DETERGENTS AND RELATED SUBSTANCES IN BRITISH

Federal Water Pollution Control Administration, Cincinnati, Ohio.

M. B. Ettinger.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 112. 3 ref.

Descriptors: *Detergents, *Linear alkylate sulfonate, *Aromatic compounds, Biodegradation, Biochemical oxygen demand, Waste water treat-

ment, Chromatography.
Identifiers: *Polyglycols, Alkyl alcohol ethoxides,
Nonionic detergents, Phenol derivatives, Alcohol
derivatives, Aromatic ethoxides.

Degradation of polyglycols or nonionic detergents does not necessarily mean that there will be no remaining residues with surface active properties or other undesirable characteristics. The extraction procedure and the extract washing procedure used in thin-film chromatographic analysis seem unlikely to recover many glycol chain residues which have been shown to be at least moderately resistant to biodegradation. Field studies at treatment facilities revealed some penetration by biodegradable materials of five different secondary sewage treatment systems. Therefore adequate treatment will not completely solve the problem. (See also W71-04691) (Lowry-Texas) W71-04692

DISCUSSION OF, 'NONIONIC DETERGENTS AND RELATED SUBSTANCES IN BRITISH WATERS'

Koniklijke/Shell-Laboratorium, Amsterdam

(Netherlands). P. L. Kooijman.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 113-114. 1 ref.

Descriptors: *Chromatography, *Detergents, Biodegradation, Waste water treatment. Identifiers: Chloroform extraction, Cobalto thiocyanate method, Polyethylene glycol, Ethylene oxide, Carboxylate.

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The cobalto-thiocyanate method color formation with nonionics is dependent upon the ethylene oxide content of the nonionics. If the ethylene oxide chain of a nonionic is shortened by biological attack, the resultant product may intensify the color of the complex, thus resulting in considerable error. The thin layer chromatographic method is not subject to error from this source. Thin layer chromatograms have distinguished between nonionic and polyethylene glycol. If complete separation is possible, it should be possible to analyze intermediate products of biodegradation. (See also W71-04691) (Lowry-Texas) W71-04693

DISCUSSION OF 'NONIONIC DETERGENTS AND RELATED SUBSTANCES IN BRITISH WATERS'

Monsanto Co., St. Louis, Mo.

R. D. Swisher.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 114-115. 4 ref.

Descriptors: Detergents, Biodegradation, *Surfactants, Waste water treatment, Chromatography. Identifiers: Chloroform extraction, Polyglycols, Alkylphenon ethylene oxide, Carboxylate, Hard nonionic detergents, Soft nonionic detergents.

Several factors have combined to hamper the study of the biodegradation of nonionic surfactants, and the detection of their presence in water. The surfactants are present only in extremely dilute solu-tion when compared to potentially interfering materials. In addition, biodegradation itself proceeds through a series of steps involving many times the formation of complicated complexes which are difficult to monitor in their degradation processes. A degrading system may contain not only the original molecules, but hosts of new and different compounds to confuse the issue still further. Other compounds may be more easily extracted with chloroform resulting in considerable error in the resulting thin film chromatographs. Therefore, it would seem that thin film chromatography must undergo further research and development before being regarded as a precise investiga-tive tool. (See also W71-04691) (Lowry-Texas) W71-04694

AEROBIC SLUDGE STABILIZATION IN SEWAGE TREATMENT PLANTS,

Technische Hochschule, Hanover (West Ger-

Dietrich Kehr.

Proceedings of the Third International Conference, Munich, Germany, 1966, p 143-152. 7 fig, 19 ref.

Descriptors: *Biodegradation, *Digestion, Organic loading, Microorganisms, Nitrogen, Phosphorus, Biochemical oxygen demand, Industrial wastes, Municipal wastes, *Sludge, Sewage treatment, Waste water treatment.

Identifiers: *Aerobic sludge stabilization, Technical digestion limit, Stabilized sludge, Sludge age, Sludge load.

Aerobic sludge stabilization and its economic and technical aspects have been investigated as a substitute for the use of large digesters employed in the anaerobic digestion process. The general design basis of design of an aerobic stabilization tank is .01 cubic meters/capita, or approximately 30% of the volume of a digester designed for the same load. On the other hand, aerobic stabilization requires energy in the form of pumping and compressors required to put oxygen into the system, whereas anaerobic digestion produces usable energy. Therefore a cost comparison of the two methods should be made in every case in order to determine which is less expensive. Sewage treatment plants serving 10,000 people or less are in many instances already employing joint activated sludge waste treatment and sludge stabilization. Indications are that separate processes are feasible for plants serving up to 100,000 people, if the cost of electrical power is less than 1.2 cents/kw hour. (See also W71-04696 thru W71-04698) (Lowry-Texas) W71-04695

DISCUSSION OF 'AEROBIC SLUDGE STA-BILIZATION IN SEWAGE TREATMENT

PLANTS', Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia).

Jan Chudoba. Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 153-157. 1 fig, 17 ref.

Descriptors: Digestion, Synthesis, Kinetics, Stabilization, Organic loading, Biodegradation, Chemical oxygen demand, Biochemical oxygen demand, Activated sludge, Water purification, Sewage, Aeration, Waste water treatment.

Identifiers: *Endogenous metabolism, *Sludge yield coefficient, *Sludge age, *Extended aeration, Volatile suspended solids, Mixed liquor suspended

Two methods of aerobic sludge stabilization are presently employed in practice. Extended aeration has long been practiced, and for it to operate optimally, the following guidelines must be followed. Detention time in the aeration tank must be 24 hours, followed by 4-6 hour sedimentation time, while the organic loading must be from 240-320 g BOD5/day/cubic meter and the sludge loading cannot exceed .1 g BOD5/day/g Vss. Problems which occur are mainly due to poor sludge settleability, causing much of the organic material to pa through the outlet in the form of suspended solids. Formulae have been developed to determine the amount of non-degradable material which will remain, and the amount of degradable material which will be oxidized. The second method consists of separate aeration of sludges under continuous or discontinuous conditions. For this type of treatment, the aeration period is a function of certain sludge characteristics, notably the volatile suspended solids content. Experiments showed that higher volatile solids removals were effected at the lower loading rates. Temperature is also a significant factor. The higher the loading rate, the less the sludge will settle, and this usually requires installation of some additional sludge handling device, or separate sludge aeration tank. (See also W71-04695) (Lowry-Texas) W71-04696

DISCUSSION OF 'AEROBIC SLUDGE STA-BILIZATION IN SEWAGE TREATMENT PLANTS'.

Texas Univ., Austin.

Joseph F. Malina, Jr.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 157-160. 1 tab, 4 ref.

Descriptors: *Anaerobic digestion, *Aerobic treatment, *Stabilization, Organic loading, Degrada-tion, Synthesis, Microorganisms, Ammonia, Oxida-tion, Activated sludge, Waste water treatment. Identifiers: *Primary sludge, Oxygen consumption, Detention Time, Volatile solids. *Stabilization, Organic loading, Degrada-

Much data has been accumulated to determine the relative merits of aerobic versus anaerobic sludge stabilization. The data presented here show significant advantages for the anaerobic method when dealing with primary sludge. The anaerobic process has a much lower growth rate, consequently more of the organic material is destroyed rather than synthesized into new cell material. Carbon removals and ammonia nitrogen production also achieved much higher levels in the anaerobic process. The amount of volatile solids destroyed anaerobically increased with increased organic loading, whereas the amount destroyed aerobically remained essentially constant. When dealing with waste activated sludge, however, the outlook is much changed. The much lower content of volatile solids and higher difficulty of degrading products which are already fairly well stabilized makes utilization of anaerobic treatment, although possible, economically unfeasible in the degradation of waste activated sludge. Therefore, the decision between aerobic and anaerobic treatment cannot be based solely on the systems themselves, but must also be a function of the waste to be treated. (See also W71-04695) (Lowry-Texas) W71-04697

DISCUSSION OF 'AEROBIC SLUDGE STABILIZATION IN SEWAGE TREATMENT PLANTS',

Kurita Central Labs., Yokohama (Japan). Minoru Okazaki, and Jenji Kato.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 160-163. 2 fig, 1 tab.

Descriptors: *Aerobic treatment, *Stabilization, *Odor, Orthophosphorous compounds, Respiration, Biodegradation, Organic loading, Microorganism, Activated Sludge, Waste water treatment. Identifiers: *Reductase activity, Japan.

The Japanese have found that aerobic sludge stabilization plants are more easily constructed and operated, but their increasing prevalence in that country has been attributed to their lack of objectionable odors. Batch-type laboratory scale studies of activated sludge have revealed that the release of phosphate into sludge liquor is parallel to the progress of sludge stabilization and also to the reduction of the oxygen uptake rate. Sludge concentration cannot be considered a constant since it increases with each nutrient feeding of an activated sludge reactor. The higher the sludge concentration the higher the nutrient decomposition rate and thus sludge stabilization rate. This sludge increase cannot go on indefinitely, since each successive run increases the content of non-volatile matter in the sludge and increases the difficulty of degradation. When an excessive accumulation has been reached, sludge must be withdrawn for disposal. Since the stabilization has been aerobic, however, the stabilized sludge can be disposed of without serious troubles and unpleasant odors. (See also W71-04695) (Lowry-Texas) W71-04698

EFFECTS OF SLUDGE CONDITIONING WITH

LIME ON DEWATERING, Lurgi Gesellschaft fuer Chemotechnik m.b.H., Frankfurt am Main (West Germany).

H. Sontheimer.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 165-180. 11 fig, 2 tab, 11 ref.

Descriptors: *Lime, *Dewatering, *Centrifugation, *Neutralization, Filtration, Flocculation, Coagulation, Sedimentation, Chemical precipitation, Al-kalinity, Hydrogen ion concentration, Waste water treatment, Sludge, *Sludge treatment. Identifiers: Lime bonding capacity, Lime addition, Vacuum filtration, Thickening, Reaction time.

A new sludge de-watering process, known as the Carbofloc process has been developed. This process is suitable for handling both fresh and digested mixed sludges, and has already been successfully applied on a commercial scale. Lime is added to the incoming sludge, and contributes not only the normal dehydrating effect of lime itself, but also a lime bonding effect. Every sludge has a different lime-bonding capacity, and this characteristic is a major variable in lime addition sludgedewatering processes. After the lime addition, with its subsequent dehydrating effect, the mixture is neutralized with CO2, the end result being the conversion of free calcium hydroxide to insoluble caicium carbonate. When this neutralization is carried to the point where fixed calcium is converted to CaCO3, transcoagulation takes place, resulting in improved thickening properties and higher solids content during filtration and contrifuging. The higher the lime bonding capacity is the higher the

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increase in solids content will be. Therefore, the total process involves compression of solids not separable on centrifuges by reaction with lime and CO2 so that sedimentation with dewatering and complete separation on decanting centrifuges is possible. (See also W71-04700 thru W71-04702) (Lowry-Texas) W71-04699

FORMAL DISCUSSION OF 'EFFECTS OF SLUDGE CONDITIONING WITH LIME ON DE-WATERING', Ruhrverband, Essen (West Germany).

Ulrich K. Moeller.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 180-187. 5 fig, 2 tab, 5 ref.

Descriptors: *Dewatering, *Calcium hydroxide, *Lime, *Vacuum drying, Adsorption, Adhesion, Capillary water, Iron compounds, Colloids, Aeration, Flocculation, Coagulation, Activated sludge, Sewage, Waste water treatment.

Identifiers: *Metal hydroxides, Filter cake, Electro-

Three basic types of sludge water have been dealt with. In order of increasing difficulty of separation, they are interspace water, adhesion and capillary water, and adsorption and internal water. Work is required to overcome the liquid-solid binding forces to dewater the sludge. The influence of gravity is enough to remove interspace water, but mechanical dewatering devices are needed to cope with the other waters. Calcium hydroxide, when used in the presence of metal salts or carbon dioxide, reduces the binding forces which hold the liquid to the solids. The effective range, however, is restricted to the water binding. The overall investigations did confirm the utility of lime as an effective and economical aid in sludge dewatering. (See also W71-04699) (Lowry-Texas) W71-04700

DISCUSSION OF 'EFFECTS OF SLUDGE CON-DITIONING WITH LIME ON DEWATERING', Tokyo Univ. (Japan).

Akinori Sugiki.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 188-192. 3 fig, 3 tab, 2 ref.

Descriptors: *Calcium carbonate, *Dewatering, *Vacuum drying, Lime, Centrifugation, Sedimentation, Coagulation, Flocculation, Sludge, Waste water treatment.

Identifiers: *Sludge conditioning, Chemical conditioning, *Elutriation, Specific resistance, Particlesize distribution.

Sludge conditioning, to decrease the specific resistance of filtration, depends upon factors such as particle shape, particle-size distribution, compressibility of sludge, and the ratio of organic solids and The three commonly used conditioning methods are addition of fine mineral solids, chemical conditioning, and elutriation. Also, any combination of the three methods may be used together to provide better treatment. Coagulant requirements for sludge conditioning are composed of the sludge water requirement, and the sludge solid requirement. Chemical reactions of the sludge water with the coagulant may produce ammonium and calcium carbonates. Calcium carbonate, also formed at times by CO2 addition is a problem in that bonded calcium carbonate builds up in the filter cake, and it will not dewater. (See also W71-04699) (Lowry-Texas) W71-04701

DISCUSSION OF 'EFFECTS OF SLUDGE CONDITIONING WITH LIME ON DEWATERING', West Hertfordshire Main Drainage Authority, Rickmansworth (England). Richard Wood.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 192-194. 1 tab.

Descriptors: *Lime, *Dewatering, Vacuum drying, Activated sludge, Sewage, Sludge disposal, Waste water treatment.

Identifiers: *Lime-bonding capacity, Flash-drying, Pressure filtration, Chlorinated copperas, Aluminum chlorohydrate, United Kingdom.

The two principle methods of dewatering in the United Kingdom today are pressure filtration with lime and copperas as sludge conditioners, and vacuum filtration using either chlorinated copperas or aluminum chlorohydrate. Lime has been applied only in situations where a metal filter medium is used. The variability of the activated sludge process itself prevents standard comparisons of pressure filtration versus vacuum filtration. Investigations have revealed, in agreement with other authors, that addition or iron salts after liming produces no change. Skepticism over the ability of lime and to further consolidate settled solids is expressed, much of the increased solids content being attributed to the lime bonding capacity and the amount of calcium carbonate precipitated. (See also W71-04699) (Lowry-Texas) W71-04702

POPULATION DYNAMICS IN BIOLOGICAL TREATMENT PLANTS.

Water Pollution Research Lab., Stevenage (En-

A. L. Downing, and G. Knowles.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 117-136. 10 fig, 1 tab, 13 ref.

Descriptors: Kinetics, *Bacteria, *Protozoa, *Mathematical model, *Biodegradation, Metabolism, Acclimatization, Nitrification, Detergents, Aeration, Hydrogen ion concentration, Activated sludge, Water purification, Biological treatment, Microorganisms, Waste water treatment, Treat-

ment facilities.
Identifiers: *Population dynamics, *Nitrosomonas, Anionic detergents.

Very little basic information is presently known about the relative numbers, activities, and nutritional requirements of the various types of microorganisms that can gain access to activated sludge plants. Predictions of removal of anionic detergents and degree of nitrification based upon population dynamics correspond very well with actual observed values. Mathematical models based on growth and decay rates are formulated to explain the rate of removal of certain substrates. Removal of a particular substrate from a waste water depends upon whether or not conditions existing in the treatment system are favorable for the growth of organisms capable of degrading the substance in question. The critical variables are temperature, pH, detention time, and whether or not any sub-stances specifically toxic to the organism in question are present. Also, a certain acclimatization period may be required to establish the growth of a new organism. Hopefully, a more thorough knowledge of the growth patterns of the mixed microbial populations present in biological reactors will provide more insight into design conditions and procedures in the future. (See also W71-04704 thru W71-04706) (Lowry-Texas) W71-04703

DISCUSSION OF 'POPULATION DYNAMICS IN BIOLOGICAL TREATMENT PLANTS',

Water Economics Research Inst., Warsaw (Poland).

Jerzy Ganczarcyk. Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 136-173.

Descriptors: *Mathematical models, *Biodegradation, *Activated sludge. Detergents, Organic compounds, Nitrification, Biological treatment, Waste water treatment.

Identifiers: *Population dynamics, Intermediates, Enrichment, Over-aeration.

The work done by Downing and Knowles is supported, to a large extent, by work done in Poland by Ganczaryck, although several differences were noted. First of all, the sorption of certain substances on activated sludge flocs was selective and did not resemble closely the phenomenon of the Freundlich Isotherm. Also, the substances were often oxidized partially to form equally complicated intermediates, making determination of the biodegradable portion quite difficult. Secondly, the formulations could not explain fully the influence of physical factors on population dynamics, the interaction of activated sludge population in the degradation of some organics, or the limitation of one stage activated sludge processes in the elimination of some difficult organics. (See also W71-04703) (Lowry-Texas) W71-04704

DISCUSSION OF 'POPULATION DYNAMICS IN BIOLOGICAL TREATMENT PLANTS', Water Pollution Research Lab., Stevenage (En-

Ross É. McKinney.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 137-140. 3 tab.

Descriptors: *Bacteria, *Protozoa, *Metabolism, Microorganisms, Activated sludge, Detergents, Oxygen demand, Hydrogen ion concentration, Nutrients, Mixing, Oxygen, Temperature, Nitrification, Waste water treatment.

Identifiers: Mixed microbial populations, Pure culture, *Population dynamics, Waste retention time, Empirical Microbial mass

The parameters which are controlled by an engineer in an activated sludge plant are, waste retention time, pH, nutrient elements, mixing, oxygen, microbial mass, and temperature. All other elements are fixed by the nature of the waste and the metabolic rates of the microorganisms. Population dynamics should be approached from the funda-mentals, rather than from complex empirical mathematics. A very carefully designed and controlled study of the combined bacterial and protozoan system is needed to provide engineers with a better fundamental understanding of population dynamics. (See also W71-04703) (Lowry-Texas) W71-04705

DISCUSSION OF 'POPULATION DYNAMICS IN BIOLOGICAL TREATMENT PLANTS', Indian Inst. of Science, Bangalore. Dept. of

Biochemistry.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 140-141.

Descriptors: Microbiology, Biochemistry, Kinetics, Detergents, Nitrification, Protozoa, Bacteriology, Clarification, Activated sludge, Mathematical models, Waste water treatment. Identifiers: *Population dynamics.

Numerous investigators have discovered that no matter what the origin of the waste being treated, the protozoan population remained constant. Protozoan activity may vary by species, but when taken as a whole the range of variation is so limited as to allow them to be considered a constant. Bacterial populations show no such specialization. Several features of the activated sludge process mechanics are: (1) it is rapid, (2) it removes both harmful impurities and bacteria, (3) successful operation depends upon maximum 'activity' being maintained by optimum aeration conditions, (4) it readily undergoes putrefactive changes in the absence of sufficient oxygen, (5) it increases

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greatly in volume during purification. These are the essential features which a satisfactory explanation of the activated sludge process must cover. (See also W71-04703) (Lowry-Texas) W71-04706

RELEASE OF SOLUBLE ORTHO-PHOSPHATE IN THE ACTIVATED SLUDGE PROCESS,

Kurita Central Labs., Yokohama (Japan). Yasuhiro Sekikawa, Shozo Nishikawa, Minoru Okazaki, and Kenji Kato.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 261-276. 15 fig, 4 tab, 5 ref.

Descriptors: *Phosphorous compounds, *Activated sludge, *Microorganisms, Industrial wastes, Metabolism, Disinfection, Phenols, Poisons, Biochemical oxygen demand, Waste water treatment, Aerobic treatment, Sludge treatment, *Orthophosphorous compounds.

*Aerobic Identifiers: *Ortho-phosphates, *Aerobic digestion, Warburg respirator, Manometric apparatus, Sludge volume index, Volatile suspended solids, Mixed liquor, Aldehydes, Endogenous respiration.

During periods of unfavorable growth conditions, such as nutrient deficiency, low dissolved oxygen concentration, or the presence of toxic or inhibitory materials, activated sludge cultures will release orthophosphate back into solution. This conclusion, supported by the data presented in the figures and tables, suggests that phosphate variation might serve as an indicator of the physical condition of a biological treatment process. Measurement of phosphate concentration on a continuous basis will provide the plant operator with information as to how well the process is faring in regards to whether the microorganisms are working in as favorable an environment as possible. Further studies under more complicated operating conditions are a necessity in order to more fully understand the physical parameters of the system that are directly related to the change in phosphate concentration, and also those that are directly affected by the conditions which cause variations in the phosphate concentration. (See also W71-04708 and W71-04709) (Lowry-Texas) W71-04707

DISCUSSION OF 'RELEASE OF SOLUBLE ORTHO-PHOSPHATE IN THE ACTIVATED SLUDGE PROCESS',

Illinois Univ., Urbana.

R. C. Engelbrecht. Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 276-280. 1 tab, 16 ref.

Descriptors: *Orthophosphorous compounds, *Nitrogen, *Slimes, *Adsorption, Eutorphication, Dissolved oxygen, Aeration, Biochemical oxygen demand, Activated sludge, Waste water treatment. Identifiers: Luxury uptake, Assimilation, Adenosine tri phosphate, Biosynthesis, Organic carbon, Protoplasm, Mixed liquor suspended solids, Orthophosphates.

The level of phosphorous in an activated sludge tank has been proposed as an indicator of the ac tivity of the microorganisms in the system. Much variation in phosphorous uptake has been observed in various parts of the world. Phosphorous uptake in excess of normal requirements for biosynthesis is the subject of much debate. Luxury uptake, storage, synthesis of ATP, and adsorption onto the floc are a few of the mechanisms proposed to explain this excess uptake. Regardless of what mechanism causes the uptake, methods of continually monitoring the phosphorous content in the raw sewage, in the areation tank, and in the effluent are necessary before any application of phosphorous level as an indicator of biological treatment becomes practical. (See W71-04707) (Lowry-Texas) W71-04708

DISCUSSION OF 'RELEASE OF SOLUBLE ORTHO-PHOSPHATE IN THE ACTIVATED SLUDGE PROCESS',

Vattenbyggnadsbyran Ltd., Stockholm (Sweden).
Nils L. G. Westberg.
Proceedings of the Third International Conference

on Water Pollution Research, Munich, Germany, 1966, p 281-283. 6 ref.

Descriptors: *Orthophosphorous compounds, *Iron compounds, *Eutrophication, *Dissolved oxygen, Aeration, Microorganisms, Metabolism, Nutrients, Biochemical oxygen demand, Activated sludge, Waste water treatment.

Sewage often contains considerable amounts of This iron occurs mainly as iron hydroxide compounds which possess a high capacity of adsorbing phosphates. If considerable amounts of iron are intermittently present in the influent, the accuracy of the phosphorous level as an indicator of biological activity will be highly questionable. While no iron is present, the role of phosphorous as an indicator of biological activity has been well documented by several investigators. However, when considerable accuracy is necessary, this method falls short. Oxygen concentration has long been accepted as an indicator of biological activity, and with the advent of improved continuous dissolved oxygen monitors, it is doubtful that any other indicators should be preferred to dissolved oxygen level. (See also W71-04707) (Lowry-Tex-W71-04709

THE INACTIVATION OF ENTEROVIRUSES IN SEWAGE BY CHLORINATION,

Technion - Israel Inst. of Tech., Haifa. Hillel I. Shuval, Samuel Cymbalista, Alberto Wachs, Yitzhak Zohar, and Natan Goldblum. Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, 1966, p 53-69. 4 fig, 12 ref.

Descriptors: *Viruses, *Coliform, *Vircide, *Chlorination, Waste water treatment, Sewage, Enteric bacteria.

Identifiers: Plaque forming units, Residual, Contact time, Hydroextraction, Have Echovirus, Inactivation, Israel. Haifa, *Poliovirus,

The inactivation by chlorine of echovirus and poliovirus was compared with the inactivation of coliforms by chlorine in the Haifa, Israel sewage treatment plant. The pH ranged from 7.7 to 7.8, and the experiments were carried out at 20 plus or minus 2C. The chlorine formed complexes which are lower in disinfection ability than free chlorine. Chlorine residual was always above .3 milligrams per liter. Echovirus followed known inactivation patterns which were a function of time and chlorine concentration, being 99% inactivated after 30 minutes at 3.6 milligrams per liter of chlorine. Poliovirus was less sensitive with 50% and 90% reduction in 6 hours with 5 and 8 milligrams per liter respectively. The inactivation of echovirus was somewhat comparable to that of coliforms although the overall study indicated that coliform index in chlorinated sewage may not give a true picture. Inactivation of viruses seeded in sewage in concentrations many times greater than those normally present in sewage may not be representative of actual field situations. To carry out studies with normal wild virus concentrations, methods for detecting minimal virus concentrations as low as 1-10 plaque forming units, per liter are required. (See also W71-04711 and W71-04712) (Lowry-Texas) W71-04710

DISCUSSION OF, 'THE INACTIVATION OF ENTEROVIRUSES IN SEWAGE BY CHLORINA-

TION', Federal Water Pollution Control Administration,

Cincinnati, Ohio. Norman A. Clarke.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, p 44-46, 1966. 1 tab, 5 ref.

Descriptors: *Viruses, *Chlorination, *Disinfection, Trickling filters, Coliform, Bacteria, Sewage

treatment, Waste water treatment.

Identifiers: *Enteroviruses, Inactivation, Polio viruses, Echovirus 12, Coxsackie A9, Fecal streptococcus, Plaque counts, Hydro-extraction, Chlorine residual.

Virus inactivation was monitored in primary treatment facilities, trickling filters, activated sludge, and chlorine disinfecting units. It was found that little or no virus inactivation occurred in primary treatment, and that the effluents from secondary treatment facilities contained viruses as often as did the raw sewage. The trickling filter reduced the levels somewhat, but still did not provide a nearly virus free effluent. The activated sludge unit provided 90% removal of poliovirus, and 98% removal of Coxsackie A9 virus. Bacterial reductions were much less subject to variation in these tests than were viral reductions. Studies indicated that a 9 mg/l concentration residual of chlorine during a 15 minute contact time would be sufficient to inactivate viruses. Raw sewage chlorinated to levels of .1 to .3 mg/l showed no reduction of active viruses over non-chlorinated effluents. From this analysis it was evident that chlorination as it is now being handled is not sufficient to prevent viral growth. Much work is needed to provide methodology with which to analyze viral concentrations in water samples. Also, residual chlorine measurements must be taken along with the samples in order to determine whether a virus is particularly virulent, or whether the chlorine has been reduced to a biologically inactive level. (See also W71-04710). (Lowry-Tex-W71-04711

DISCUSSION OF 'THE INACTIVATION OF ENTEROVIRUSES IN SEWAGE BY CHLORINA-

TION', Vienna Univ. (Austria). Hygiene Inst.

G. Weber-Schutt.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, p 47-49, 1966. 1 fig, 1 tab, 1 ref.

Descriptors: *Viruses, *Bacteriophage, *Radioactivity techniques, Epidemiology, Pathogenic bac-teria, Municipal wastes, Waste water treatment. Identifiers: Staphylococcus phage 3C, Sodium 24, Poliomyelitis, Clarification, Emscher tank.

A municipal sewage treatment plant, having a weak sewage from a combined sewer as influent, and consisting of an Emscher tank, trickling filter, and final settling tank, was seeded with staphylococcus phage 3C. 15 minutes after the phage seeding, radioactive sodium was added. Concentration of the phages was monitored at the outlets to the three stages of the treatment plant, as was the level of radioactivity. The flow through curves were then graphed and included in the report. 66% of the phage particles passed through the plant and into the receiving stream. This experiment was then duplicated in a similar plant with similar results. Although not all viruses behave in exactly the same manner as the particular phage used, many do react quite similarly. From these test results it was obvious that plants of this type do not provide adequate inactivation of viruses, and they must be redesigned or replaced. (See also W71-04710). (Lowry-Tex-W71-04712

THE ROLE OF AERATION IN THE ACTIVATED SLUDGE PROCESS, Hydraulic Research Inst., Prague (C-

zechoslovakia). Vladimir Zahradka.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, p 53-69. 4 fig, 3 tab, 30 ref.

Descriptors: *Turbulence, *Mixing, Nutrients, Flocculation, Coagulation, Sedimentation, Water purification, *Activated sludge, Sludge, Sludge treatment, Waste water treatment, *Aeration.

Identifiers: Aerated space activity, Floc morphology, Food to micro-organisms ratio, Mechanical suppressor, Filamentous sludge, Oxidation rate.

The combination of factors known as the aeration space activity is the new basis for activated sludge design work. Activated sludge dry weight, where the food to microorganism ratio does not approach the state of non-flocculent growth is unable to represent the purification capacity of an activated sludge tank reactor. The aeration space activity can be determined by an experiment in which all process parameters must be applied in full scale, including the mixing factor. In most cases, the mixing factor influences the aerated space activity to a much greater extent than does the sludge loading factor. As long as high oxygenation capacity is required, then the power requirements are not significantly different for the several types of aerators. and consequently, the power requirement is not a determining factor in the aeration system design. (See also W71-04714 thru W71-04716). (Lowry-W71-04713

FORMAL DISCUSSION OF THE ROLE OF AERATION IN THE ACTIVATED SLUDGE PROCESS',

Department of the Seine, Paris (France). Sanitary Services

M. Feuillade.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, p 69-72, 1966, 6 ref.

Descriptors: *Aeration, *Oxygenation, *Turbulence, Metabolism, Microorganism, Biodegradation, Dissolved oxygen, Biochemical oxygen demand, Activated sludge, Waste water treatment. Identifiers: Respiratory activity, Oxygen capacity, Specific intensity, Purification efficiencies, Sludge liquor, Beckman electrode, Zarhadaka, Paris,

Despite much research on the subject, the proponents of small bubble aeration are still in disagreement with the proponents of large bubble aeration as to which bubble size is actually optimal for activated sludge. Experiments conducted at the Purification Plants of the City of Paris, the Department of the Seine, the Experimental Center at Colombes, and the Purification Plant of Acheres support the coarse or medium bubble system as providing the greatest overall benefit for the activated sludge system. The differences in aeration efficiencies between large and small bubbles become smaller as the oxygenation capacity becomes larger. Also, larger bubbles break up the growth patterns of filamentous organisms, while at the same time providing the best use of the aeration power for flocculating the sludge blanket and settling organic substances on the sludge. The Beckman electrode was used to obtain values of dissolved oxygen present in a sample of activated sludge. This equipment is correct only within 10%, and the most economical design will not be possible until oxygen levels at all points in the tank at all times can be continuously monitored. (See also W71-04713). (Lowry-Texas) W71-04714

DISCUSSION OF 'THE ROLE OF AERATION IN THE ACTIVATED SLUDGE PROCESS', Ruhrverband, Essen (West Germany).

G. Rincke.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, p 72-78. 4 fig, 13 ref.

Descriptors: *Submergence, *Boundary layers, *Pilot plants, Aeration, Turbulence, Activated sludge, Waste water treatment.

Identifiers: Contact frequency, Specific surface, Comminution, Specific aeration intensity, Mixing rate, Sludge loading, Oxygen transfer. Turbulence activates the biological processes according to work done at the Ruhrverband in Germany over the past several years. Oxygen uptake is a function of the frequency of contact which increases in proportion to the velocity gradient. Increased velocity gradient G, provides increased shear forces proportional to G to the 2nd power. These shear forces mechanically comminute the floc, giving it a larger specific surface for the biological activities. Sludge loading, then, expressed in Kg BOD5/day/Kg dry solids can be used only as an auxiliary term. Experiments also showed that bubbles flowing into an aeration tank were subjected to too many unknown or incalculable influences to follow a strict mathematical derivation. The geometric conditions of an aeration tank were proven to be of considerable significance, especially for the judgement of experimental results. Oxygen transfer experiments showed medium bubble aeration to achieve nearly the same transfer rate under similar conditions as fine bubble aeration. (See also W71-04713). (Lowry-Texas) W71-04715

DISCUSSION OF 'THE ROLE OF AERATION IN THE ACTIVATED SLUDGE PROCESS'

Technische Hochschule, Vienna (Austria) Wilhelm Von Der Emde.

Proceedings of the Third International Conference on Water Pollution Research, Munich, Germany, p 79-81, 1966.

Descriptors: *Oxygenation, *Turbulence, Mixing, Aeration, Biochemical oxygen demand, Activated sludge. Waste water treatment.

Identifiers: Specific aeration intensity, Immersion depth, Inka-aeration, Bubble-aeration.

The 'specific aeration intensity', introduced by Zahradka allows several different aeration devices with different immersion depths to be easily compared. While it is possible to get better oxygenation efficiencies at higher aeration intensities, this is not always the case. To achieve an effluent quality of 25 mg/l BOD5, the oxygenation capacity should range from 2-3 Kg O2/day/cubic meter, and 3-5 Kg O2/day/cubic meter for partial treatment. Table I shows average values obtained from a series of tests at Hamburg 1964-1965. At present, there is no common denominator for comparison of wideband and furrow aeration with surface aerators. The energy input related to one cubic meter of aeration tank for one hour is proposed as such a yardstick. Turbulence should be considered as a factor along with but not totally in place of aeration time and sludge loading factors. While turbulence is a significant factor, it is of no greater importance than the conventionally accepted parameters. (See also W71-04713). (Lowry-Texas) W71-04716

PLANNING COOLING WATER FOR POWER STATIONS.

Central Electricity Generating Board, London (England). Station Planning Board.
K. M. Gammon.

Advances in Water Pollution Research, Fourth International Conference on Water Pollution Research, Prague, Czechoslavakia, p 927-936, April 21-25, 1969. 4 fig, 3 tab, 6 ref.

Descriptors: *Cooling water, *Cooling towers, *Power stations, *Thermal pollution, Cooling, Heated water, Evaporation.

Identifiers: *Great Britain, *Thames, Salt scaling, Purge discharge.

Water is required to make up evaporation and purge. The amount of purge is related to the nature of the source and to the treatment given. Analysis on inland wet tower cooled stations abstracting fresh water and discharging to rivers, and direct cooled stations on tidal waters taking and returning much greater volumes of brackish or salt water are presented in this paper. Chemical changes in water used for cooling and complex. Investigations show purge discharges to be well aerated with more concentrated salts in solutions and some heat added. With cooling towers heat is lost to the atmosphere by evaporating about 1% of the water circulated in the cooling water system. Salts in solution are progressively concentrated by this evaporation and will eventually lead to deposition of scale. Scaling on the river surface of condenser tubes reduces heat transfer rates, and its control is an important aspect in operation. It is stated that purge discharges can be integrated with benefit into river management schemes. Heat is the main addition to cooling water discharges. This can have both immediate and long-term effects. Care is taken to avoid rapid successive reheating of water for operational and environmental reasons. (Herrera-Van-W71-04724

EFFECTS OF AXIAL DISPERSION ON THE OP-TIMAL DESIGN OF THE ACTIVATED SLUDGE PROCESS

Kansas State Univ., Manhattan. Dept. of Chemical Engineering.

L. T. Fan, G. K. C. Chen, L. E. Erickson, and M. Naito

Water Research, Vol 3, No 4, p 271-284, April 1970. 14 p, 7 fig, 19 ref.

Descriptors: *Optimization, *Activated sludge, *Aeration, *Mathematical models, Costs, Organic

Identifiers: *Axial dispersion, Pattern search technique.

The axial dispersion (longitudinal mixing) which occurs in the aeration chamber of the activated sludge system was investigated to determine the effects of axial dispersion on system performance. A so-called diffusion model was employed to characterize the flow in the aeration chamber. A pattern search technique in conjunction with the quasilinearization technique for solving the split boundary value problem of the nonlinear differential equation was used to determine the optimum design of the system. Two economic models. the overall size (total volume) of the aeration chamber and clarifier, and the total construction cost based on Smith's correlation for unit costs of subunits of the activated sludge process, were optimized and the results were compared. This analysis showed that the Peclet number, which indicated the extent of longitudinal fluid mixing or dispersion in the aeration chamber, and the feed concentration of organic sewage are two important parameters which affect optimum design of activated sludge systems. Longitudinal mixing appeared undesirable, especially when the feed concentration of organic sewage was large. (Kriss-Cornell) W71-04768

DIGITAL COMPUTER SIMULATION WASTE TREATMENT PLANTS USING THE WATCRAP-PACER SYSTEM,

Waterloo Univ. (Ontario). Dept. of Chemical En-

For primary bibliographic entry see Field 07C. W71-04772

MATHEMATICAL MODEL FOR WATER-WASTE WATER SYSTEMS.

Bechtel Corp., San Francisco, Calif. Scientific Development Dept.

Clark L. Weddle, S. K. Mukherjee, J. W. Porter, and H. P. Skarheim.

Journal American Water Works Association, Volume 62, No 12, p 769-775, December 1970. 7 p, 8 fig, 2 tab, 6 ref.

Descriptors: *Optimization, *Network design, *Mathematical models, *Waste water treatment, *Water demand, *Costs, Linear programming, Municipal water, Waste water disposal, Water supply. Identifiers: Least-cost analysis, Out-of-kilter al-

Group 5D—Waste Treatment Processes

A network analysis-based model for selecting the least-cost water supply and waste water disposal system for a municipal area was developed. The basic elements considered included treatment of conventional water, seawater, and waste water, and storage and conveyance requirements. Lines or 'arcs' were assigned for each function or activity and each end of every arc was given a designation, termed a 'node'. A closed loop cycle was established by interconnecting all sources with all demands. For each arc used, a unit cost was assigned to the flow. The general purpose network program, based on an integer-linear programming method, used an out-of-kilter algorithm. To account for nonlinear cost functions and to formulate the input data correctly an iteration process was developed which used a preprocessing program and a recosting program. Model use included development of: the network, quality criteria and treatment requirements, cost information, least cost solution, and reiteration. The effects of blending conventional water sources with distilled seawater were considered. The example problem involved two municipal water demands, one industrial cooling water demand, one industrial process water demand, and one agricultural irrigation demand, and water supplies from two conventional water treatment plants and one seawater distilla-tion plant. Input data and example solutions were given. (Kriss-Cornell) W71-04774

WATER REUSE SYSTEMS ANALYSIS,

Institute for Water Resources (Army), Alexandria, Va.; and Colorado State Univ., Fort Collins. Dept.

of Civil Engineering.

A. Bruce Bishop, and David W. Hendricks.
Journal of the Sanitary Engineering Division,
ASCE, Vol 97, No SAI, p 41-57, February 1971.
17 p, 3 fig, 9 tab, 10 ref, 2 append.

Descriptors: *Systems analysis, *Optimization, *Water reuse, *Costs, Transportation, Waste water treatment, Tertiary treatment, Desalination, Linear programming, Water demand, Utah. Identifiers: *Origin-destination matrix, Salt Lake

A systems approach for analyzing water reuse alternatives was developed for sequential and recycle water reuse which delineated optimal allocations from each supply category to each use sector of an origin-destination matrix for minimization of costs. Three levels of treatment were included: (1) conventional primary-secondary; (2) tertiary; and (3) desalting. A classical transportation algorithm, using linear programming was adapted to include cost of delivering water having a specified quality from each origin to each destination. Treatment cost, as well as the transport cost, was included. A case study of the agro-urban-industrial region of the Salt Lake City area demonstrated an application of the model to a specific metropolitan area. Least cost results for levels of demand for the years 1965, 1980, 2000, and 2020 showed a changing pattern of allocation. The model showed that for 1965, surface and groundwater supplies were sent directly to user destinations, with effluents to system outflow; by 1980 tertiary treatment enters the picture; and by 2020 desalting, and surface and groundwater blending with output from tertiary treatment and desalting plants becomes important. (Kriss-Cornell) W71-04778

ECOLOGY OF FOULING ORGANISMS IN A POLLUTED AREA,
Democritus Nuclear Research Center, Athens

(Greece). Hydrobiology Group. Lydia Ignatiades, and Th. Becacos-Kontos. Nature, Vol 225, No 5229, p 293-294, January 17, 1970. 1 fig, 6 ref.

Descriptors: Water pollution effects, Ecology, *Microorganisms, *Fouling, *Growth rates, *Settlement, Lethal limit, Oily water, Oil wastes, HarIdentifiers: Toxic tolerance, *Oil pollution, Oil spillage, Athens, Greece, Harbor pollution.

Fouling organisms were studied in an oil polluted area of Pireus Port, near Athens, Greece. Growth and settlement rates were observed, using wooden test blocks for settlement. Poor light conditions due to suspended mud seemed to favor attachment and the organisms successfully tolerated the toxicity of the polluted water. (Ensign-PAI) W71-04798

PUBLIC WATER SUPPLY AND SEWER SYSTEM (FINANCIAL SUPPORT FOR MU-NICIPAL SEWAGE TREATMENT WORKS). For primary bibliographic entry see Field 06E. W71-04843

KINETICS OF AEROBIC UTILIZATION OF MIXED SUGARS BY HETEROGENEOUS MICROBIAL POPULATIONS,

Georgia Inst. of Tech., Atlanta. Environmental Resources Center.

Sambhunath Ghosh.

Environmental Resources Center, Georgia Institute of Technology, WRC-0969, November 1969. 467 p, 73 fig, 18 tab, 411 ref. FWPCA Training Grant 5T1-WP-62-03--05.

Descriptors: *Biological treatment processes, *Waste water treatment, *Microorganism growth kinetics, *Aerobic conditions, *Water quality control, Cellular metabolism, Biomass synthesis, Amino acids, Nutrient transport. Identifiers: *Glucose, *Galactose, *Monod growth

kinetic model.

The objectives of the research was to delineate the roles of biochemical, physiological and physical factors in the causation of phasic uptake of organic nutrients in waste stabilization systems and to formulate basic kinetic models for predicting biomass production and the uptake rates of component substrates from mixtures. The research was performed in a chemostat type reactor using influents which contained glucose and galactose as the competing substrates. Results of continuous culture studies using heterogeneous aerobic cultures showed that the rates of biomass production and of assimilation of individual substrates were controlled by that substrate which allowed the highest growth yield and permitted the maximum specific growth rate when presented as the sole carbon and energy source. Changes in dilution rates induced concomitant changes in the physiological character of the dominant reactor population, and this phenomenon played an important role in causing concurrent assimilation of competing substrates in completely mixed continuous flow processes. In batch or plug flow reactors the utilization pattern may be concurrent or sequential depending on the physiologic character of the seed population employed and the initial concentration ratio of substrates. Equations were presented for describing the courses of eliminations of component sub strates and biomass production in completely mixed or continuous flow processes. (Conway-Georgia Tech)
W71-04848

5E. Ultimate Disposal of Wastes

COLLECTION AND DISPOSAL OF FARM

Ministry of Agriculture (Northern Ireland). For primary bibliographic entry see Field 05D. W71-04486

EFFECTS OF MARINE SEWAGE DISPOSAL, Water Pollution Research Lab., Stevenage (En-

gland). E. B. Pike, and A. L. H. Gameson. Control. Vol 69, Water Pollution Control, Vol 69, No 4, p 355-382, 1970. 149 ref.

health. *Diseases, *Public Descriptors: *Epidemiology, Recreation, Water quality, Water pollution, Ecology, Aesthetics, Fish, Bacteria, Shellfish, Standards, Waste water treatment, *Sewage disposal, Water pollution effects.

Identifiers: *Medical aspects.

The main objections to the discharge of untreated sewage to the sea are raised on aesthetic and medical grounds. Aesthetic objections are often well founded and can be overcome by suitable screening or disintegration of the sewage before discharge. The medical problems arising out of marine discharge are quite insignificant and the objections and standards are based primarily on the possibility rather than the probability of contacting enteric disease. There appears to be no need for a standard based epidemiological evidence as a standard based on aesthetics would suffice. However, shell-fisheries have special needs for unpolluted waters for public health reasons and because their ecology is easily damaged. An open discussion by delegates is included. (Ellis-Texas) W71-04491

TREATMENT OF PHOTOGRAPHIC LABORA-TORY WASTES AT NORTON AIR FORCE BASE, CALIFORNIA,

Montgomery Research, Inc., Pasadena, Calif. For primary bibliographic entry see Field 05D. W71-04500

POSSIBLE TOXIC EFFECTS OF CYANATES, THIOCYNATES, FERRICYANIDES, FERROCYANIDES AND CHROMATES DISCHARGED TO SURFACE WATER,

Montgomery Research Inc., Pasadena, Calif. For primary bibliographic entry see Field 05C. W71-04501

DISPOSAL OF BRINES PRODUCED IN RENOVATION OF MUNICIPAL WASTE WATER.

Burns and Roe, Inc., Oradell, N.J.

Copy available from GPO Sup Doc as 167.13/4:17070DLY, \$1.25; microfiche from NTIS as PB-197 597, \$0.95. Water Pollution Control Research Series ORD-17070 DLY 05/70, May 1970. 113 p, 16 tab, 25 fig, 33 ref, append. FWQA Program No 17070 DLY.

Descriptors: *Ultimate disposal, *Brine disposal, Municipal wastes, Deep wells, Injection wells, Evaporation, Brines, *Disposal, Costs, Effluents, *Waste water disposal, Waste water treatment, Texas, Arizona, Colorado.
Identifiers: Brine wastes, *Municipal waste water,

Waste water renovation, El Paso (Tex), Tucson (Ariz), Denver (Colo), Deep well injection, *Solar evaporation, Brine reduction, Multistage flash evaporation.

Costs of ultimate disposal of brine wastes from municipal water renovation schemes have been investigated for the sites of El Paso, Texas Tucson, Arizona and Denver, Colorado. Based on 10 million gallons per day, 7% fixed charge rate, and 12 mills/Kwhr power cost, estimated costs are as follows: Near El Paso, Texas, brine can be dumped on worthless arid land at a cost of \$.052/Kgal. It can be injected into the saline Hueco-Bolson Basin at \$0.13/Kgal. Solar evaporation in local ponds, using 30 mil liners and a pipeline to convey residual brine 50 miles for ultimate disposal, costs \$0.18 Kgal. Solar evaporation east of Denver, using ponds with a 30 mil liner, would cost \$0.76/Kgal. Alternately, solar evaporation east of Pueblo, Colorado in lined ponds would cost \$0.96/Kgal., including the pipeline from Denver. Multistage flash evaporation to 10% solids would reduce the amount of brine and the size of the solar ponds to a point where they might be acceptable. Their combined cost, based on \$0.46/mbtu steam and steam-driven pumps is \$0.54/KGAL. of brine effluent. Well injection is unfeasible here, due to earthquakes. At Tucson, the temporary measure of using injection wells to

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3500 feet while awaiting the Southwest Water Plan would cost \$0.13/Kgal. A permanent scheme, using local solar ponds with 30 mil liners would cost \$0.18/Kgal., including costs for a residual brine pipeline to the Wilcox Plaza 50 miles eastward. W71-04614

CHARACTERIZATION, TREATMENT, AND DISPOSAL OF URBAN STORMWATER,
Robert A. Taft Sanitary Engineering Center, Cin-

cinnati, Ohio. For primary bibliographic entry see Field 05D. W71-04687

SOIL ENRICHMENT EXPRESS.

Corps of Engineers, Washington, D.C. Warren J. Papin.

Water Spectrum, Army Corps of Engineers, p 16-17, Winter 1970.

Descriptors: *Ecology, Operations research, *Sludge disposal, *Municipal wastes, *Sewage sludge, Soil management, Environmental engineer-

Identifiers: *Environmental problems, Water resources planning.

One pressing environmental problem today is the growing volume of sludge which is extracted from the constant flow of sewage. The common solution is to flush it down a convenient river or into a lake. The Metropolitan Sanitary District of Greater Chicago, however, has found a beneficial solution; they are shipping it out to area farmers for use as fertilizer. Most nations use human wastes as fertilizer, but without treatment wastes can be dangerous to health. The Soil Enrichment Materials Corporation of Chicago (SEMCO) leaves the sludge in a semiliquid form (slurry) is pumped into holding lagoons then to railroad tank cars where it is then transported to farm lands. In tests conducted last year in conjunction with the University of Illinois and the US Department of Agriculture, results proved that sludge can produce excellent The fertility of sludge is in organic form, providing for slow release over a long period of time. As such, it is much less susceptible to loss by leaching and runoff than inorganic fertilizers. Sludge has been used to rejuvenate sterilized ground and sand filled areas. (Wray-Chicago)
W71-04751

BOTTOM FAUNA IN A SEA AREA NORTHWEST OF HELGOLAND, SELECTED FOR INDUSTRIAL WASTE DISPOSAL, (IN

For primary bibliographic entry see Field 05C. W71-04828

5F. Water Treatment and **Quality Alteration**

SOCI-ECONOMIC FACTORS RELATED TO THE INCIDENCE OF WATER-BORNE DIS-EASE.

Puerto Rico Univ., Mayaguez. Water Resources Research Inst.

George C. Uzdavinis

Available from NTIS as PB-197 674, \$3.00 in paper copy, \$0.95 in microfiche. Technical Completion Report, Nov. 1970. 49 p, 2 ref, 16 tab, 2 fig. OWRR Project A-018-PR (1).

Descriptors: *Water pollution effects, Soil contamination effects, Economic impact, Income, *Public health, Social impact, *Social aspects, *Puerto Rico.

Identifiers: *San German (PR), Gastroenteritis, Pueblo Nuevo, El Recreo.

An attempt was made to determine whether socioeconomic factors were related to the incidence of the water-borne disease gastroenteritis in two housing areas within the town of San German in

southwestern Puerto Rico. By the use of a questionnaire survey made in a substandard housing area and one made in a housing project, the author elicited income and education level information from the inhabitants. Socio-economic data were compared with the number of cases of the disease treated at the public health center from each area. The results were inconclusive. (Holmes-Rutgers) W71-04675

AMENDED 1964 MASTER PLAN OF WATER-WORKS IMPROVEMENTS FOR BOARD OF WATERWORKS COMMISSIONERS, MADISON, WISCONSIN, 1969 REVISION.

Black and Veatch, Kansas City, Mo. For primary bibliographic entry see Field 08A.

LINEAR PROGRAMMING APPLIED MULTI-STAGE CAPACITY EXPANSION OF TREATMENT-DISTRIBUTION SYSTEM.

Illinois Univ., Urbana. Dept. of Business Administration.

Hirohide Hinomoto.

A paper presented at the 38th National ORSA Meeting, October 28, 1970. 32 p, 3 fig, 3 tab, 17

Descriptors: *Water supply, *Water requirements, *Water demand, *Water distribution, *Municipal water, *Linear programming, Capital costs,
Operating costs, Illinois, Mathematical models, Water treatment, Distribution systems, Treatment

Identifiers: *Facilities expansion.

An optimal plan was developed for expanding the capacity of municipal water treatment-distribution systems. Linear programming is applied to the multi-stage capacity expansion of a municipal water treatment-distribution system in order to determine the required sizes of new treatment plants and distribution reservoirs and the times at which they should be added to the system. The capital and operating costs of each type of facility are represented by exponential functions in concave form showing economies of scale available with an increase in capacity. Linear functions in polygonal form approximate each nonlinear cost function, thereby transforming the original nonlinear formulation to a linear program. For illustration, the linear program formulated is applied to the water supply system serving the twin city of Champaign-Urbana, Illinois, and its vicinity under assumed conditions approximating the real situations. The system obtains water from practically unlimited under-ground sources. Finally, the use-fulness of the model depends much on the availability of reliable information on future demands and the capital and operating cost functions related to the types of facilities considered. Since most cost data available in published studies are not useful for the present model, the collection of reliable current data for determining cost functions usually is prerequisite to the successful application of this model. (Poertner) W71-04737

5G. Water Quality Control

VESSEL POLLUTION CONTROL.

Federal Water Quality Administration, Edison, N.J. Water Quality Lab.

Federal Water Quality Administration, Edison Water Quality Lab Research Newsletter, Vol 1, December 1970. 12 p.

Descriptors: *Recreation wastes, *Water pollution sources, *Boating, *Water pollution control, Sewage, Waste water (Pollution), Projects, Sanita-

ry engineering.
Identifiers: *Boating wastes, Outboard motor

This report describes on-going and completed FWQA research development and demonstration projects for controlling waste pollution from water-craft, outlines the problem of pollution from outboard motors, discusses water quality standards for vessels; and details proposed research and development needs for controlling vessel pollution. This can be accomplished through grants, contracts, and in-house efforts. The many watercraft of all classes which use American waters are capable of utilizing the water resources in any of our 50 states and can deposit varying amounts of wastes at any location causing localized pollution. It is estimated that the total daily waste discharged from all watercraft approximates the wastes from a city of one-half million people. (Knapp-USGS) W71-04363

MAP SHOWING AREAS SERVICED BY MU-NICIPAL AND PRIVATE SEWERAGE AGEN-CIES, SAN FRANCISCO BAY REGION, 1970, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07C. W71-04367

DETERMINING **SEEPAGE** CHARAC-TERISTICS OF MILL-TAILINGS DAMS BY THE FINITE-ELEMENT METHOD,

Bureau of Mines, Spokane, Wash. Mining Research

For primary bibliographic entry see Field 08D. W71-04425

COOLING TOWER APPLICATION,

Kohloss (Frederick H.) and Associates Inc., Honolulu, Hawaii. For primary bibliographic entry see Field 05D. W71-04442

TEMPERATURE VARIATIONS IN DEEP RESERVOIRS,

Cornell Univ., Ithaca, N.Y. Dept. of Water Resources Engineering. Yu-Leuk Choi.

Journal of the Hydraulics Division, Proceedings of the ASCE, Vol 96, No HY10, p 2154-2158, October 1970. 1 fig, 1 ref.

Descriptors: Reservoirs, Thermal stratification, Model studies, Temperature.
Identifiers: *Temperature variations, Effective dif-

The essential features of the model described are the methods used to allow for advection and convective mixing at the water surface. It is assumed that density is a monotone decreasing function of temperature in the range considered. Some as-sumptions are used, such are: all horizontal planes are isotherms within the region of water impoundment, inflow enters the system at the elevation where the resident water has the same temperature; outflow rate at any elevation is equal to the withdrawal rate at that elevation. Both inflow and outflow are algebraically additive in the upward vertical direction. These specify the pattern of total vertical flow in the reservoir. These also complete the one-dimensionality of the system and leads to the simplification that temperature distribution is describable by considering only the conservation of mass and heat energy. (Herrera-Vanderbilt) W71-04446

ECONOMIC AND ADMINISTRATIVE PROBLEMS OF WATER POLLUTION,

Oregon State Univ., Corvallis. For primary bibliographic entry see Field 06B. W71-04450

ECONOMIC GROWTH AND ENVIRONMEN-TAL COSTS.

Coe Coll., Cedar Rapids, Iowa. For primary bibliographic entry see Field 06B. W71-04451

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TECHNOLOGICAL INJURY,

Blackburn Coll. of Technology and Design (En-

gland). For primary bibliographic entry see Field 06G. W71-04465

WATER POLLUTION,

Mersey and Weaver River Authority (England). For primary bibliographic entry see Field 06B. W71-04466

LABORATORY STREAM STUDIES OF A BENTHIC COMMUNITY, Missouri Univ., Columbia. Dept. of Sanitary En-

gineering.
Gale Allen Wright.
MS thesis, 1970. 70 p, 32 fig, 27 ref, append.
OWRR Project A-011-MO (2).

Descriptors: *Self-purification, *Algae, *Streams, Laboratory tests, Dissolved oxygen, Hydrogen ion concentration, Alkalinity, Respiration, Photosynthesis, Carbon dioxide, Primary productivity, Biodegradation, Organic matter, Oxygen, Chemical oxygen demand, Benthos. Identifiers: *Oxygen balance.

The aim of this study was to determine the role of algae in biodegradation of organic wastes and self-purification of streams. The monitoring of the system in a laboratory stream microcosm was accomplished by determination of dissolved oxygen, pH, and bicarbonate-carbonate alkalinity. The results indicated a lesser constancy of production process in comparison with that of respiration. The carbon:oxygen ratio was influenced by the age of algal cells. The oxidation of organic substances occurred during periods of darkness. Photosynthetic production was limited by the available carbon dioxide. The contribution of algae to selfpurification of water appeared to be very low. The determination of photosynthetically produced oxygen could not be reliably accomplished before the synthesized material had been oxidized. (Wilde-Wisconsin) W71-04518

EFFECT OF ENVIRONMENTAL FACTORS ON BENTHAL OXYGEN DEMAND,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering. S. Douglas Hall.

MS thesis, 1966. 60 p, 11 fig, 5 tab, 25 ref, append. OWRR Project A-003-PA (1).

Descriptors: *Benthos, *Decomposing organic matter, *Streams, *Bottom sediments, Aerobic conditions, Anaerobic conditions, Oxygen demand, Respiration, Mathematical studies.

Identifiers: Oxygen concentration, Slab Cabin Run

Benthal aerobic-anaerobic decomposition in the ecto- endo-zones of bottom sediments are described. The study was conducted in a laboratory reaction chamber using benthos samples collected from a small stream. A decrease in oxygen concen-tration of supernatant water was paralleled by a lower rate of oxygen demand of benthal material, although the latter slightly increased with the depth of the benthos. The rate of oxygen concentration and utilization was controlled by the inver-tebrate:bacteria respiration ratio. The respiration of macroinvertebrates accounted for 40 to 60% of the total OD. The total respiration of the benthal layer investigated was expressed by an empirical equation incorporating bacterial respiration, the number of invertebrates, and oxygen concentration at 20C. (Wilde-Wisconsin) W71-04519

A REVIEW OF WEED CONTROL, REVIEW OF HERBIVOROUS FISH FOR

Bureau of Sport Fisheries and Wildlife, Warm Springs, Ga. Southeastern Fish Control Lab. Joe B. Sills.

The Progressive Fish-Culturist, Vol 32, No 3, p 158-161, 1970. 12 ref.

Descriptors: *Fish, *Herbivores, *Aquatic weed control, Tilapia, Carp, Algae, Rooted aquatic plants, Plankton, Arkansas, Insects, Turbidity, Chara, Pondweeds.

Identifiers: Tilapia nilotica, Tilapia mossambica, Tilapia melanopleura, Cyprinus carpio, Ctenopharyngodon idellus.

There is growing interest in biological pest control as a substitute for pesticides. Fish receiving most attention for aquatic weed control possibilities are Tilapia nilotica, T mossambica, melanopleura; the Israeli strain of carp (Cyprinus carpio); and the Chinese or grass carp (Ctenopharyngodon idellus). Results obtained with each are reviewed. All tests in which Tilapia were stocked in ponds resulted in overcrowded populations and unsatisfactory weed control. Although the carp is effective in reducing or controlling aquatic plants, detrimental aspects of its presence make its usage undesirable in recreation and fishing waters. Tests showed that the Israeli strain is not primarily herbivorous, but roots in the bottom much as wild carp do. Observations are continued to learn why the Israeli strain does not reproduce in ponds with mixed populations. All observations to date on the grass carp are most favorable. It does feed on aquatic vegetation. There is no indication of natural reproduction, but the fish can be spawned. As its native habitat is similar to some of our large river systems, the grass carp may adapt to them. More information is needed for its use except in strictly controlled environments. (Jones-Wisconsin) W71-04528

THE FOREST AS A STOREHOUSE OF CITY WATER, (IN GERMAN),

Vienna (Austria). For primary bibliographic entry see Field 03B. W71-04535

FEASIBILITY STUDY MANUAL - MINE WATER POLLUTION CONTROL DEMONSTRATIONS.

NUS Corp., Pittsburgh, Pa. Cyrus Wm. Rice Div.

For sale by Superintendent of Documents U.S. Government Printing Office, Wash, D.C. 20402, 167.13/4:14010FLW \$0.65. Microfiche from NTIS as PB-197 594, \$0.95. Water Pollution Control Research Series 14010 FLW 07/70, June 1970. 65 p, 2 fig, 3 ref, 4 append. FWQA Program 14010

Descriptors: *Acid mine water, *Water pollution control, *Feasibility, *Project feasibility, *Feasibility, *Feasib bility studies, Project planning, Federal project policy, Optimum development plans, Programs, Project purposes, Water pollution treatment, Abatement

Identifiers: *Mine drainage abatement.

This manual is to be used as a guide by State or interstate agencies in uniformly performing feasibility studies for projects proposed to demonstrate methods for the abatement of mine drainage pollution as required by Section 14 of the Federal Water Pollution Control Act as amended. The required feasibility studies are to aid the Secretary of the Interior in selecting the mine drainage pollution control method or methods suitable for demonstration, and also the optimum watershed where the effectiveness of the project will have the greatest public value or uses. (Knapp-USGS) W71-04545

COLLECTED **PAPERS** REGARDING NITRATES AGRICULTURAL WASTE WATERS.

Federal Water Quality Administration, San Francisco, Calif.

For primary bibliographic entry see Field 05B. W71-04546

GENESIS AND SCOPE OF INTERAGENCY COOPERATIVE STUDIES OF CONTROL OF NITRATES IN SUBSURFACE AGRICULTURAL WASTE WATERS.

Bureau of Reclamation, Sacramento, Calif.

Edgar P. Price.
In: Collected Papers Regarding Nitrates in Agricultural Waste Waters, Federal Water Quality Administration Water Pollution Control Research Services of the Programme 1969, 14 ries 13030ELY 12/69, p 1-14, December 1969. 14 p, 2 fig, 2 tab, 8 ref. FWQA Project 13030ELY.

Descriptors: *Water pollution sources, *Return flow, *Nitrates, *Water pollution control, *California, Drainage engineering, Drainage effects, Irrigation programs, Irrigation systems, Water management (Applied), Eutrophication, Path of pollu-tants, Groundwater, Irrigation effects, Drainage water, Water quality, Excess water (Soils), Return flow, Drainage programs.

Identifiers: *San Luis Drain (Calif), *San Joaquin

Master Drain (Calif), *Central Valley (Calif).

The programs of the United States and the State of California to build San Luis Drain and San Joaquin Valley master drain, and the concern for water quality in San Francisco Bay prompted a coopera-tive investigation of methods for removing nitrates from subsurface agricultural waste water. The investigation broadened to include examination of the source of the nitrates and the changes in nitrate form which might occur spontaneously or which might be induced as the subsurface water is col-lected and conveyed through California's San lected and conveyed through California's San Joaquin Valley to the head of the San Francisco Bay System. The results of the investigation are very briefly reviewed and presented in summary ta-bles. (See also W71-04546) (Knapp-USGS) W71-04547

PREDICTING CHANGES IN NITROGENOUS COMPOUNDS IN SOIL-WATER SYSTEMS,

Arizona Univ., Tucson. Marvin J. Shaffer, Gordon R. Dutt, and William J. Moore.

Moore.
In: Collected Papers Regarding Nitrates in Agricultural Waste Waters, Federal Water Quality Administration Water Pollution Control Research Series 13030ELY 12/69, p 15-28, December 1969.
14 p, 7 fig, 4 tab, 9 ref. FWQA Project No 13030E-LY; Bur Reclam. Contract No 10-06-D-6464.

Descriptors: *Simulation analysis, *Path of pollutants, *Return flow, *Nitrates, Mathematical models, Computer programs, California, Water Mathematical pollution sources, Leaching, Drainage water, Ammonia, Drainage effects, Groundwater, Water quality, Soil water.

Identifiers: *Groundwater pollution, *Central Vallev (Calif).

A digital computer program was developed to model soil-water systems with respect to nitrogen transformations, including hydrolysis of urea, immobilization-mineralization of ammonia and organic nitrogen, and immobilization of nitrate nitrogen. Comparisons were made of predicted and observed data for several soils having different textures and various moisture contents, temperatures, and fertilizer applications. This procedure yielded simple correlation coefficients of 0.99, 0.97, and 0.97 for the urea, organic, and ammonia nitrogenous types. A model predicting the concentrations of nitrogenous species occurring in soilwater systems aids in planning management criteria for pollution control and fertilizer programs. (See also W71-04546) (Knapp-USGS) W71-04548

COMBINED NUTRIENT REMOVAL AND TRANSPORT SYSTEM FOR TILE DRAINAGE FROM THE SAN JOAQUIN VALLEY, California State Dept. of Water Resources, Fresno; and Federal Water Quality Administration, Fresno, Calif.; and California Univ., Berkeley. Dept. of Sanitary Engineering and Public Health. For primary hibliographic anteriors Find ACP. For primary bibliographic entry see Field 05D. W71-04557

WHERE IS URBAN HYDROLOGY PRACTICE

Department of Housing and Urban Development, Washington, D.C.
For primary bibliographic entry see Field 04C.

W71-04572

HYDRAULIC PROPERTIES RELATED TO STREAM REAERATION,

Georgia Inst. of Tech., Atlanta. School of Civil En-

gineering. E. C. Tsivoglou, and J. R. Wallace.

Research supported by grant from Federal Water Quality Admin. In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/31, p 509-522, 1970. 14 p, 2 fig, 2 tab, 8 ref.

Descriptors: *Reaeration, *Mixing, *Turbulent flow, *Tracers, Dye releases, Radioactivity flow, *Tracers, Dye releases, Radioactivity techniques, Tritium, On-site tests, Air-water interfaces, Cavitation, Turbulence, Water pollution control, Water pollution treatment, Model studies. Identifiers: *Krypton.

Field tracer experiments were designed to investigate the relationships between the reaeration capacity of a flowing stream and the stream's hydraulic properties, to develop models for the accurate prediction of stream reaeration capacity. Accurate knowledge of stream reaeration capacity is a necessity in determining the required degree of waste treatment and the associated costs. Reaera-tion is a direct function of the rate of surface water replacement due to turbulent mixing. Recent development of a gaseous radiotracer technique permits field measurement of reaeration. This procedure involves the simultaneous use of three tracers, namely a fluorescent dye for time of flow, tritiated water for accurate dispersion measurement, and dissolved krypton-85 for measurement of gas transfer. Field results, obtained by this technique are highly reproducible. Field tracer studies of the reaeration capacities of three medium sized streams were conducted over a total of about fifty river miles. Associated hydraulic properties such as stream flow, cross-sectional area, depth, velocity, hydraulic gradient and dispersion were also measured. Features such as waterfalls, rapids and pools are included. More than eighty observations of the reaeration capacities of individual stream reaches were made. In streams of the type studied most of the real work of gas transfer and reaeration takes place in relatively short reaches. In general, the magnitude of the gas transfer coefficient is controlled by the rate of surface water replacement and this in turn is controlled by the rate of energy expenditure, measured as the rate of loss of water surface elevation. (Knapp-USGS) W71-04593

CONTROL OF SPILLAGE OF HAZARDOUS

POLLUTING SUBSTANCES,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.

G. W. Dawson, A. J. Shuckrow, and W. H. Swift. Copy available from GPO Sup Doc as 167.13/415090FOZ10/70, \$3.00; microfiche from NTIS as PB-197 596, \$0.95. Water Pollution Control Research Series, 15090 FOZ 10/70, Nov 1, 1970. 390 p, 28 tab, 31 fig, 105 ref, 9 append. FWQA Program 15070 FOZ 10/70.

Descriptors: *Water quality, *Accidents, *Chemicals, Monitoring, *Costs, *Water pollution control, Water pollution sources, Legislation, *Chemical

wastes, Chemical properties.
Identifiers: *Hazardous polluting substances,
*Countermeasures, *Spills, *Critical concentrations, *Enforcement, *Hazardous materials, Acute discharges, Detection.

An evaluation of the water quality aspects germane to the spillage of hazardous polluting substances is developed. Emphasis is placed on definition and classification of chemical materials; the nature of

the sources of spillage and past experience; and analysis of the relative threat to water quality offered by such substances; a review of presently available detection, control, and removal technology; relationship to water quality standards; and the relevant administrative, enforcement, and cost recovery aspects. Over 800 chemical substances were evaluated as to their annual production and transport quantities, their critical concentration in the aquatic environment resulting in water quality impairment for the several beneficial water uses, detection limits (both field and laboratory), and the control and removal methods presently the control and removal methods presently available or potentially practicable. Over 250 chemicals and compounds, generally those in large scale production and utilization, are priority ranked in order of relative threat to water quality in terms of annual production/sales, intrinsic hazard to water quality, transport mode, and past statistical accident frequency. Recommendations are presented regarding future research and development efforts aimed at mitigating damage and a consensus of informed parties is presented relating to the need for additional legislation. This report fulfills Contract No. 14-12-866, between the Federal Water Quality Administration and the Pacific Northwest Labora tories, Battelle Memorial Institute. The right of a citizen to bring an action to abate pollution without showing specific damage to himself ought to be granted under the Refuse Act in both State and Federal law. The qui tam theory should not be expanded. Rather, class action rights should be authorized with no monetary rewards provided to the plaintiff, other than the recovery of costs when he prevails. This is particularly true when the prosecution of hazardous polluting substances (spill cases) is so inadequate at both the State and Federal level. Any damages recovered would go into funds established to effect environmental restoration in the event cleanup or restoration at a specific spill site were impossible or undesirable. W71-04615

CONCEPTUAL ENGINEERING REPORT

KINGMAN LAKE PROJECT. Weston (Roy F.) Inc., West Chester, Pa. For primary bibliographic entry see Field 05D. W71-04616

THE FEDERATION AND PURE WATERS,

Dwight F. Metzler.
Journal, Water Pollution Control Federation, Vol 40, No 8, Part 1, p 1397-1402, Aug 1968. 6 p, 1

Descriptors: *Pollution abatement, *Water pollution control. *Administrative agencies, *Personnel, Water quality control, Federal government, Public health, Grants, Manpower, Training, Waste water disposal, Waste water (Pollution), Planning, Administration, Operation and maintenance, Financing, Costs, Public utilities, Education, Social aspects.

The Water Pollution Control Federation has done much to focus public concern on water pollution abatement. Its member associations such as the New York State Water Pollution Control Association have made important contributions. The New York Pure Waters Authority has been created to assist the Pure Waters program by construction of waste water facilities and technical assistance for operation of the facilities on a community level. The program needs to place more emphasis on the recruitment of competent personnel by offering at-tractive salaries, upgrading the public image of such employment, and promoting of training--especially in the management and supervision areas. The Federation should set up procedure and facilities for a sustained recruitment. Technical training for better plant operation, which is of paramount importance, can be improved by supplementing state training programs. The seminar-workshop approach by state acceptance can be utilized to proach by state associations can be utilized to put objectives into practice. There is a need for better communication between the Federation members and the public. (Barnett-Florida) W71-04640

PERMITS FOR DISCHARGES OR DEPOSITS INTO NAVIGABLE WATERS.

Corps of Engineers, Washington, D.C. For primary bibliographic entry see Field 06E. W71-04646

FINANCIAL RESPONSIBILITY FOR OIL POL-LUTION CLEANUP.

Federal Maritime Commission, Washington, D.C. For primary bibliographic entry see Field 06E. W71-04647

INTERNATIONAL AND NATIONAL REGULA-TION OF POLLUTION FROM OFFSHORE OIL

PRODUCTION,
Nospaman, Waters, Scott, Krueger and Riordan,
Los Angeles, Calif.

For primary bibliographic entry see Field 06E. W71-04650

OCEAN POLLUTION: AN EXAMINATION OF THE PROBLEM AND AN APPEAL FOR INTERNATIONAL COOPERATION,

For primary bibliographic entry see Field 06E. W71-04651

THE ECONOMICS OF CLEAN WATER: ANIMAL WASTES PROFILE. Federal Water Pollution Control Administration,

Washington, D.C. For primary bibliographic entry see Field 05B. W71-04685

THE NUCLEAR POWER SCHEDULE STRUG-

For primary bibliographic entry see Field 06B. W71-04722

TEMPERATURE CONTROL ENHANCES NATURAL BENEFICATION OF COAL MINE DRAINAGE,

Cornell Univ., Ithaca, N.Y.

R. Lachman.

International Congress on Industrial Waste Water, Stockholm, Sweden, Typescript. 12 p, 1 fig, 5 tab, 9

Descriptors: *Coal mine wastes, *Temperature, Pyrite, Oxidation, Neutralization, Iron, Alkaline water, Impoundments, *Mine drainage. Identifiers: Natural benefication.

Although it is impossible to say that there is any one key factor in the benefication of coal mine effluents, a major factor was found to be the complex interrelationship of effluent, air, and receiving water temperatures. The acid effluents discharged from coal mines are produced as the result of the oxidation of pyritic materials to either ferrous or ferric sulfate followed by the leaching of these products into streams. The field experiment con-sisted of the construction of small impoundment dam in which benefication resulting from the controlled mixing of mine and surface waters could be stuided under natural environmental conditions. The criteria used for determining that benefication had occurred were changes in acidity, ferrous iron, total iron, aluminum, calcium, magnesium and sulfate content of the mixture while the acidity, ferrous iron, total iron, aluminum, and sulfate are decreasing, the calcium and magnesium remain virtually unchanged. All of the six tests performed show that the highest percent reductions in iron were obtained when the stream and effluent temperature differences were smallest. (Upadhyaya-Vanderbilt) W71-04725

ENERGY PRODUCTION - A WORLD LIMIT,

Cambridge Univ. (England). Cavendish Lab.

P. F. Chapman.

New Scientist, p 634-636, September 24, 1970. 1 fig, 1 tab.

Group 5G—Water Quality Control

Descriptors: *Solar radiation, *Thermal pollution, Energy budget, Forecasting, Water pollution con-

Identifiers: *Energy sources, Energy production, Surface temperature, Power input.

Estimates of the total solar energy incident on the Earth fall in the range of 1.49 x 10 to the 18th power to 1.55 x 10 to the 18th power kilowatthours per annum. Using the value of 280 K for the surface temperature of earth, it follows from Boltzman's Law that a one percent rise in the power input corresponds to a temperature rise of 0.7K. It is proposed that energy production should be restricted to be less than 5 percent of the total solar input. This limit corresponds to a temperature rise of 3.5 K. The maximum world hydroelectric power capacity, estimated in 1960 on the minimum flow rate of the world's major river systems, it only 0.05 percent of energy incident on the oceans. If we are to avoid increasing Earth's surface temperature by an appreciable amount, then the present trend in world energy production must soon change. In order to obtain more energy without displacing the temperature equilibrium further the equilibrium sources must be utilized. It has been estimated that present technology may be able to extract one percent of the solar radiation. Acceptance of any limit to the world's energy production implies a max-imum world population. (Upadhyaya-Vanderbilt) W71-04727

USEFUL ENERGY FROM UNWANTED HEAT, WAPORA, Inc., Rockville, Md.

J. I. Bregman. Chemical Engineering, p 83-87, January 25, 1971.

Descriptors: *Cooling water, *Thermal pollution, Cooling towers, Costs, Standards, Water pollution

Identifiers: *Waste heat, *Once-through cooling, Cooling ponds, Drift loss, Aquaculture.

Once through cooling is certainly the most economical way of accomplishing heat dissipation. The results of a study conducted by Federal Power Commission show that about 71 stations in the 1,000 to 4,000 Mw range are capable of being supported by reservoirs, 24 in the 4,000 to 12,000 Mw range, and 8 at 12,000 Mw or greater. Efficiency of a cooling pond may be increased markedly by introducing a spray into the system. Common problems connected with large cooling waters includes wood deterioration, biological fouling, the formation of deposits, corrosion and scaling. Another major problem is drift and togging. A typical tower with a flow of 250,000 gal. per minute operating on seawater with a salinity of 35,000 ppm, and a drift loss of 0.1 percent will emit about 4,400 lb. per hour of sodium chloride. Costs for dry tower runs from \$25 to \$30 per Kw., compared to \$8 to \$13 per Kw. for wet towers. Cooling water from a nuclear power plant may be particularly suited to aquaculture. Possibility of placing a chemical plant next to a nuclear plant appears attractive. It is concluded that potential does exist for turning waste heat into a useful commodity. (Upad-hyaya-Vanderbilt) W71-04728

PLASTIC COOLING TOWER SAVES SPACE AND WEIGHT. Whirlcool, Inc., Franklin Lakes, N.J.

Chemical Engineering, p 48, January 25, 1971. 1 fig.

Descriptors: *Cooling towers, Maintenance, Water loss, Corrosion, Water pollution control.

Identifiers: *Plastic cooling tower, Polyethylene.

Smaller than conventional cooling towers, and wighing 1/7th that of wood or steel construction, this model offers design engineers more leeway in installing cooling towers in tight spaces or on soft foundations. Other features are long, maintenance free service and minimum corrosion problems. The tower is fabricated from a large, one-piece seamless tubular shell of high density polyethylene that is highly resistant to acids, alkalis and salts, as well as algal growth. The units are available in models ranging in capacity from 150 to 600 gpm. Up to 5000 gpm capacity can be installed using a modular arrangement of successive towers. The internal design, or spiral/step flow arrangement, causes air and water to contact countercurrently while swirling around within spiral channels. Water loss, through carryover and drift, is kept low. (Upadhyaya-Vanderbilt) W71-04729

ECONOMICS OF THERMAL POLLUTION CONTROL,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering. G. O.G. Lof, and J. C. Ward.

Journal Water Pollution Control Federation, Vol 42, No 12, p 2102-2116, December 1970. 5 fig, 3

Descriptors: *Thermal pollution, *Thermal powerplants, Economics, Cooling water, Efficiencies, Temperature, Evaporation, Ecology, Costs, Cool-ing towers, Water pollution control. Identifiers: Recirculation cooling, Once-through cooling

Approximately 80 percent of all water used by industry is used for cooling purposes. Plots are given showing the estimated cooling water withdrawal to the year 1980 and for estimates of past and future recirculation. If the cost of supplying cooling water in a once through system, including withdrawal, pumpage, and treatment if necessary, exceeds about \$0.01/1000 gallon (0.3 mill/KWH generated in fossil fuel plants) recirculation cooling would usually be employed. On-site cost would be minimized by such decision. Regulations prohibiting unlimited thermal discharge is the other reason for using recirculation cooling. Equations are given for calculating annual investment expense and operating cost for recirculation cooling using a forced-draft cooling tower. The results of a downstream powerplant using warmer condenser water than would naturally have been available are a decrease in total electric generation and a decrease in thermal efficiency, hence, an increase in cost per kilowatt hour. Thermal discharge has the effect of diminishing downstream flows and lake volumes just as does recirculation cooling to avoid thermal discharge. (Upadhyaya-Vanderbilt) W71-04733

POLLUTION CHARGES INCOME AND THE COSTS OF WATER QUALITY MANAGEMENT, Ohio State Univ., Columbus. Dept. of Economics. J. H. Boyd.

Water Resources Research Center, Ohio State University, Columbus, Ohio, 1970. 28 p, 2 tab, 3 fig, 15 ref. OWRR Project A-010-Ohio (2).

Descriptors: *Water quality, *Water pollution effects, *Water pollution control, Biochemical oxygen demand, Flow augmentation.
Identifiers: *Effluent charges, Instream aeration.

Polluters should realize the marginal opportunity costs of utilizing rivers for waste disposal, equal to the marginal value of downstream water quality foregone. The author considers that 'pollution charges' (usually called effluent charges) represent a portion of the economic rent of the river, and that additional charges on enjoyers of water quality would be another portion of the economic rent desirable from an equity view point. Investments in facilities to increase the river's assimilative capacity such as instream aeration are costs to the river authority. The author discusses financial balance and Pareto efficiency as important to public policy. Discussion is presented which indicates that an optimizing river authority is apt to have surplus revenues. Section II of the paper examines the relationship between pollution charges income and assimilative capacity augmentation costs for a case of one upstream polluter and one downstream beneficiary. Section III discusses relationships between pollution, water quality and low flow augmentation and Section IV extends the model to more than one polluter and one beneficiary. (The model assumes ability to evaluate water quality benefits.) (Whipple-Rutgers) W71-04736

ECONOMICS OF AIR AND WATER POLLU-TION.

Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center. For primary bibliographic entry see Field 06B. W71-04739

SOMEBODY FOULED UP THE SEAS, For primary bibliographic entry see Field 06E.

THE 'FINAL' WATER WELL LAW AND REGU-LATIONS (STANDARDS FOR WATER WELL CONSTRUCTION AND PUMP INSTALLA-TION),

Ground Water Resources Inst. For primary bibliographic entry see Field 06E. W71-04742

THE USE OF SUBSIDIES FOR WASTE ABATE-

Clemson Univ., S. C. For primary bibliographic entry see Field 06A. W71-04743

WHERE NOW, CLEAN WATER,

Cornell Univ., Ithaca, NY. Water Resources and Marine Science Center. David J. Allee, and Leonard B. Dworsky. Water Spectrum, Army Corps of Engineers, p 10-15, Winter 1970. 3 fig.

Descriptors: *Resources development, *Water policy, Conservation, Ecology, Inter-agency coopera-

icy, Conservation, Ecology, Inter-agency coopera-tion, *Water pollution. Identifiers: *Water resources planning, Water supply systems, Environmental policy, Environ-mental quality, Environmental problems.

Years ago it was recognized that piecemeal approaches to water resources development were wasteful and ineffective. To combat this approach, the Water Resources Planning Act was passed in 1965. Now that act should be reconsidered--updated with new approaches for dealing with mercury, DDT, and municipal water supplies. Resource development agencies must see the urban region as a necessary unit of action in planning. Specific measures to be taken in the 1970's include: 1) removal of gross pollution from municipal and industrial outlets, 2) use of advanced waste treatment technology, 3) demonstration of regional control of pollution, 4) reduction of DDT, other pesticides, and detergents, 5) reduction in rate of deterioration of Great Lakes, 6) management of waste heat from industry, 7) improved control over oil production and transportation. In order to achieve these goals, the following suggestions are made. The federal government should enforce pollution control in all navigable waters. Also the federal construction grant allocation procedure should be extensively revised. To facilitate innovation, a series of regional water quality management studies ought to be initiated as demonstration projects. The collection of detailed information with sources of polluters identified should be authorized in order to effectively plan a pollution control program. The water supply and waste water utility services of local government should undergo a program of reorientation, and a national program of technology assessment ought to be established to insure the minimization of consequences harmful to life as a result of new materials or machines. (Wray-Chicago) W71-04748

Techniques of Planning—Group 6A

SYSTEMS ANALYSIS FOR URBAN WATER MANAGEMENT,

Water Resources Engineers, Inc., Walnut Creek Calif.

For primary bibliographic entry see Field 06A. W71-04755

SYSTEMS ANALYSIS FOR GREAT LAKES WATER RESOURCES.

Ohio State Univ., Columbus. Water Resources

For primary bibliographic entry see Field 06A. W71-04756

AN INTERINDUSTRY FORECASTING MODEL WITH WATER QUANTITY AND QUALITY CONSTRAINTS,
West Virginia Univ., Morgantown. Dept. of

Economics.

For primary bibliographic entry see Field 06A. W71-04761

REGIONAL TRADE AND STRUCTURE MODEL FOR POLLUTION ABATEMENT STUDY, Ohio State Univ., Columbus. Dept. of Economics. For primary bibliographic entry see Field 06A. W71-04763

TRADE STUDY RELEVANT TO POLLUTION ABATEMENT IN THE WESTERN BASIN OF LAKE ERIE,

Ohio State Univ., Columbus. Dept. of Economics. For primary bibliographic entry see Field 06A. **W**71-04764

THE UTILITY OF SYSTEMS ANALYSIS IN ESTUARINE WATER QUALITY MANAGE-

Manhattan Coll., Bronx, N.Y. Dept. of Civil En-

gineering.
For primary bibliographic entry see Field 06A.

SYSTEMS ANALYSIS, WATER QUALITY AND GOVERNMENT DECISION MAKING,

New York State Dept. of Health, Albany. Environmental Health Services.

For primary bibliographic entry see Field 06A. W71-04766

RECENT DEVELOPMENTS IN THE LAW OF

THE SEAS: A SYNOPSIS, For primary bibliographic entry see Field 06E. W71-04782

THE CONTROL OF POLLUTION BY OIL UNDER THE WATER QUALITY IMPROVE-MENT ACT OF 1970,

Washington and Lee Univ., Lexington, Va. School of Law.

James S. Dix, and Aron L. Suna.

Washington and Lee Law Review, Vol 27, p 278-288, 1970. 11 p, 51 ref.

Descriptors: *Oil, *Water quality control, *Water Quality Act, *Water pollution, Water pollution sources, Oily water, Water pollution effects, Water pollution control, Federal government, Legislation, Pollution abatement, United States, Oil industry, Coastal structures.

Identifiers: *Water Quality Improvement Act of

In recent years extensive damage has resulted from the increased utilization of oil in our society. Through spillage and the proliferation of offshore drilling, oil pollution of our waters has become a major problem. The Water Quality Improvement Act of 1970 is an attempt to police and alleviate oil pollution by enabling the government to recover cleanup costs from the polluter. The authors herein delineate the scope, relate the legislative history, and hypothesize as to the application of the liability provisions of the Act. The provisions of the Act are discussed, and a chart is presented summarizing exceptions to the applicability of the Act. The chart sets out limits of liability, designating where un-limited liability is applicable. The provisions of the Act are critically analyzed and suggestions for improvement are included. (Barnett-Florida) W71-04784

THE SETTLEMENT OF DISPUTES BETWEEN FEDERAL AND STATE GOVERNMENTS CON-OFFSHORE CERNING PETROLEUM RESOURCES: ACCOMMODATION OR ADJU-DICATION.

For primary bibliographic entry see Field 06E. W71-04786

FINANCIAL RESPONSIBILITY FOR OIL POL-LUTION CLEANUP (EXEMPTION OF NON-SELF PROPELLED BARGES FROM FINAN-CIAL RESPONSIBILITY REQUIREMENTS). Federal Maritime Commission, Washington, D.C. For primary bibliographic entry see Field 06E. W71-04792

CERTIFICATION OF FACILITIES (PROPOSED REGULATIONS FOR CERTIFYING POLLU-TION CONTROL FACILITIES FOR TAX **DEDUCTION PURPOSES).**

Environmental Protection Agency, Washington,

For primary bibliographic entry see Field 06E. W71-04793

EXECUTIVE ORDER 11574 (ADMINISTRA-TION OF REFUSE ACT PERMIT PROGRAM). For primary bibliographic entry see Field 06E. W71-04794

TURBULENT DIFFUSION AND ENTRAIN-MENT IN TWO-LAYER FLOW,

Norges Tekniske Hoegskole, Trondheim. River and Harbor Lab.

T. Carstens.

Proceeding, American Society of Civil Engineers, Journal of Waterways and Harbors Division, 96 (WWL) p 97-104, February 1970. 7 fig, 1 tab, 8

Descriptors: *Estuaries, *Flow control, *Turbulent flow, *Diffusion, *Entrainment, Salinity, Tracers, Sea water, *Path of pollutant, Water pollution control. Flow

A freshwater layer over a pool of seawater may extract salt by diffusion and entrainment. Diffusion is a two-way transport with equal volumes exchanging places, entrainment is a one-way advectival type of transport. The rates of the two vertical transports depend on the turbulence in the surface layer and in the pool. The more turbulent water mass will erode and entrain the less turbulent one. The distribution of salinity in an estuary is helpful in the location of freshwater intakes and can be used as a tracer to estimate transport rates of other flow pollutants. (Ensign-PAI) W71-04803

CONTROLLING OIL POLLUTION OF HAR-BORS THROUGH BIOLOGICAL MEANS. Naval Research Reviews, Vol 23, No 5, p 24-26, May 1970. 1 fig.

*Water pollution control, *Oil, Descriptors: *Fertilization, *Biodegradation, *Cleaning, *Biodegradation, *Fertilization, Nitrogen, Phosphorus, Microorganisms, Self-purification, Oil wastes.

Identifiers: Accelerated biodegradation, *Oil pollu-

The U.S. Navy has begun a research program for better methods of controlling oil pollution of harbors and beaches. The program will concentrate on decomposition of oil through natural processes. Biodegradation of the oil is the most significant self-purification process active in the oceans. The study, conducted by Rutgers University, is to find ways to speed up biodegradation. Seeding dispersants with cultures of oil-degrading microorganisms may accelerate biodegradation. Ways of fertilizing with mineral nutrients such as nitrogen and phosphorus are being studied and offer extensive laboratory experiments. Field tests will be made on shores and estuaries in New Jersey. (Ensign-PAI) W71-04805

REGIONAL ACTION: KEY TO THE FUTURE OF SAN FRANCISCO BAY/I,

California State Water Resources Control Board, Sacramento.

For primary bibliographic entry see Field 06B. W71-04809

REGIONAL ACTION: KEY TO THE FUTURE OF SAN FRANCISCO BAY/2,

California State Water Resources Control Board.

For primary bibliographic entry see Field 06B. W71-04810

CALIFORNIA DEPT OF FISH AND GAME V S S BOURNEMOUTH (SHIP'S LIABILITY FOR DAMAGES RESULTING FROM OIL SPILL). For primary bibliographic entry see Field 06E. W71-04840

ENVIRONMENTAL SERVICE (CREATION OF STATE AGENCY FOR WASTE TREATMENT CONTROL).

For primary bibliographic entry see Field 06E.

06. WATER RESOURCES **PLANNING**

6A. Techniques of Planning

A MODEL FOR CAPACITY EXPANSION PLANNING OF WATER DISTRIBUTION NET-WORKS,

Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics; and Massachusetts Univ., Amherst Dept. of Civil Engineering. Fu-Hsiung Lai, and John C. Schaake, Jr. Available fron NTIS as PB-197 557, \$3.00 in paper

copy, \$0.95 in microfiche. Massachusetts Institute copy, 50.95 in interolicitic. Massachusetts institute of Technology, (MIT), Ralph M. Parsons Lab for Water Resources and Hydrodynamics Report No 131, October 1970. 234 p, 54 fig, 22 tab, 71 ref, append. OWRR Project No B-014-MASS (1).

Descriptors: *Systems analysis, *Optimization, *Mathematical models, *Water distribution (Ap-*Mater distribution (Applied), *Network design, Distribution systems, Public utilities, Water demand, Water delivery, Water management (Applied), Water supply, Dynamic programming, Computer programs. Identifiers: *Water system expansion.

Methodology was developed for planning the capacity expansion of water distribution networks to meet anticipated future water needs. Optimal present investment decisions could be related to the annual discount rate, economy-of-scale in the cost of capacity expansion, existing network capacity, and the demand growth patterns. The general nature of water distribution network planning and the problem of single period planning for a tree network were reviewed. Dynamic programming was applied to the problem of multiperiod, single component planning. A model was developed for tree network planning. (Knapp-USGS)

W71-04351

Field 06—WATER RESOURCES PLANNING

Group 6A—Techniques of Planning

A SYSTEMS ANALYSIS OF THE LOWER GANGES-BRAHMAPUTRA BASIN, Harvard Univ., Cambridge, Mass. For primary bibliographic entry see Field 02E. W71-04410

IMPACT OF IRRIGATION DEVELOPMENT ON INCOME AND TRADE, EASTERN AND CENTRAL SOUTH DAKOTA,

South Dakota State Univ., Brookings. Dept. of Economics.

For primary bibliographic entry see Field 03F. W71-04421

SIMULATION OF BIOLOGICAL PROCESSES BY ANALOG AND DIGITAL COMPUTERS, Kansas State Univ., Manhattan. Inst. for Systems

Design and Optimization.
L. T. Fan. P. S. Shah, and L. E. Erickson

Institute for Systems Design and Optimization, Report No 20, July 1970. 120 p, 39 fig, 5 tab, 41 ref, 2 append. OWRR Project A-019-KAN (2).

Descriptors: *Analog computers, *Digital computers, Simulation analysis, *Biological treatment, Waste treatment, Flow.

In the first part of this report the analog computer, its basic components and their functions were reviewed and discussed. The state variable approach was used for the analog computer programming to solve the higher order differential equations. Suggestions were made for drawing an analog circuit diagram by dividing it into subdiagrams which were classified as the main subrouting, special function subroutine and the memory subroutine. The analog computer simulation was illustrated by the biological wastetreatment processes. The transient behavior of the system was observed for constant influent organic concentration and for constant influent flow rate during the start-up or restarting of the plant. Phase-plan plots for different flow rates were also obtained. The transient behavior of this system was observed for a cyclic influent flow rate. The second part of the re-port contained a general description of the continu-ous system modeling program for the simulation of the continuous system. The detail programming information and a description of the inputs and outputs was given. The simulation by digital computer was illustrated by simulating the batch kinetics for the growth of microorganisms on hydrocarbon substrate (a four phase reacting system). The effect of cell adsorption to the surface of the dispersed phase, substrate transport between phases, phase equilibrium and growth kinetics could be considered using this model. (Kriss-Cornell) W71-04422

EFFICIENCY AND EQUITY IN THE OPTIMAL SUPPLY OF A PUBLIC GOOD,

Maryland Univ., College Park. Martin C. McGuire, and Henry Aaron.
Review of Economics and Statistics, Vol LI, No 1, p 31-39, February 1969.

Descriptors: *Economic efficiency, *Welfare economics, *Economic evaluation, Costs, Benefits, Taxes, Government, Marginal cost, Income, Mathematical study, Decision-making, Optimization, Maximization.

Identifiers: *Lendahl solution, *Pareto efficiency, *Public goods, Marginal utility, Income transfers, Marginal rate of substitution.

The Lindahl voluntary exchange decision rule, which leaves the initial income distribution unchanged makes possible the separation of decision rules for allocative efficiency and distribu-tional equity in relation to a public good. This can be demonstrated from the following: (1) the mar-ginal costs of production need not equal the sum of the individuals marginal rates of substitution; (2) with either direct lump sum income transfers or variable cost sharing tax burdens, the choice of a final utility distribution dictates a unique Pareto optimal public goods supply decision; (3) if both

tax shares are variable and lump sum income transfers are allowed then the optimal utility distribution is Pareto-efficient and can be achieved through a Lindahl solution to the public good supply problem. These propositions are demonstrated both diagramatically and mathematically. The author summarizes the implications for the theory of taxation and expenditure. The conclusions of this paper would indicate a distinct method of cost allocation and benefit distribution for water resources projects and is therefore relevant to the water resources economist. (Murphy-Rutgers)

SYSTEMS ANALYSIS TECHNIQUES FOR PLANNING-PROGRAMMING-BUDGETING,

Rand Corp., Santa Monica, Calif. For primary bibliographic entry see Field 06B. W71-04469

THE SYSTEMS ANALYSIS APPROACH, Department of Defense, Washington, D.C. For primary bibliographic entry see Field 06B. W71-04475

UNCERTAINTY AND THE NEED FOR COL-LECTIVE ACTION, Harvard Univ., Cambridge, Mass.

Richard Zeckhauser.

In: Public Expenditures and Policy Analysis, 1970,

Descriptors: *Uncertainty, Economic evaluation, *Government, Optimization, Demand, Risk, Insurance, Flood control, Forecasting, Probability, Benefits, Capital, Income, Taxes, Marginal costs. Identifiers: *Contingent claims, *PIP goods, *Individual preferences, Equity considerations.

The author believes that the expansion of knowledge on the subject of uncertainty has not stressed the role of the government. This paper attempts to show that the presence of uncertainty creates special obligations and possibilities for collective or governmental action. The author first considers those situations in which individuals who are unable to predict their individual portions of future total demand may find it useful to make some decisions on the collective provision of a good before preferences become known. There is a discussion of the factors which make it advantageous to provide goods, for which accurate provision of future preferences is impossible, on a collective basis. The paper also evaluates the effect of trades in contingent goods having a risk-sharing objective on incentives for individual effort. The government's attitude towards risk is examined and, in the concluding section, the effect of possible governmental action on expectations is evaluated. Uncertainty is a problem in water resource analysis, as evidenced by the author's numerous references to flood control programs and this paper represents a useful source for information concerning the potential issues of uncertainty in the water resource area. (See also W71-04477) (Murphy-Rutgers) W71-04478

EVALUATION OF THE DECISION PROCESS IN WATER RESOURCES PLANNING,

Stanford Univ., Calif. Dept. of Civil Engineering. Ray K. Linsley.

Available from NTIS as PB-197 530, \$3.00 in paper copy, \$0.95 in microfiche. Engineering Economic Planning Report EEP-38, December 1970. 41 p. OWRR Project C-1635 (No 3150) (3).

Descriptors: *Project planning, *Forecasting, *Projections, Probability, Methodology, *Decision making, Reliability, Water supply, Construction costs, *Water storage, *Synthetic hydrology, Water supply, *Reservoirs, Municipal water, Risks,

Identifiers: Baltimore (Md), Phoenix (Ariz).

A summary report of research reviewing a study of methods of stochastic analysis in hydrology, application of the methods of alternative futures for estimates of urban residential water requirements and the use of statistical methods for estimating costs of dams and reservoirs. The results are a probabilistic estimate of water demand for situation simulating Baltimore, Maryland and Phoenix, Arizona were combined with estimates of the uncertainty in determining required reservoir size to indicate the probability of distributions of required storage in these two situations. It is shown that the range of required storage is very large. W71-04516

NUMERICAL SIMULATION OF DISPERSION IN GROUNDWATER AQUIFERS,

Colorado State Univ., Fort Collins. Dept. of Agricultural Engineering; and Colorado State Univ., Fort Collins. Dept. of Civil Engineering. Donald Lee Reddell, and Daniel K. Sunada. Colorado State University Hydrology Paper No 41, June 1970. 79 p, 35 fig, 1 tab, 96 ref, 8 append. OWRR Project A-001-COLO (8).

Descriptors: *Simulation analysis, *Dispersion, *Groundwater movement, *Numerical analysis, Mixing, Computer programs, Computer models, Mathematical models, Saline water intrusion, Aquifers, Porous media, Diffusion, Convection,

Identifiers: Longitudinal dispersion.

A flow equation for a mixture of miscible fluids was derived by combining the law of conservation of mass, Darcy's law, and an equation of state describing the pressure-volume-temperature-concentration relationship. The result is an equation involving two dependent variables, pressure and concentration. A relationship for determining concentration was derived by expressing a continuity equation for the dispersed tracer. An implicit numerical technique was used to solve the flow equation for pressure, and the method of characteristics with a tensor transformation was used to solve the convective-dispersion equation. The results from the flow equation were used in solving the convectivedispersion equation and the results from the convective-dispersion equation were then used to resolve the flow equation. The computer simulator successfully solved the longitudinal dispersion problem and the longitudinal and lateral dispersion problem. Using the tensor transformation, problems of longitudinal and lateral dispersion were successfully solved in a rotated coordinate system. The computer simulator was used to solve the salt-water intrusion problem. The numerical results for the fresh water head in the aquifer closely matched those obtained analytically. (See W70-04051) (Knapp-USGS) W71-04559

TOOLS FOR WATER RESOURCE STUDY, Illinois State Water Survey, Urbana.

Julius H. Dawes.

ASCE Annual and Environmental Meeting, Chicago, October 13-17, 1969. Meeting Preprint 1074. 43 p, 18 fig, 3 tab, 10 ref.

Descriptors: *Planning, *Water resources development, *Water utilization, *Administration, *Mathematical models, *Water costs, Reservoir design, Pumping, Conveyance, Sewage treatment, Wells, Pumps, Analytical techniques, Illinois.

The Illinois Water Survey determined that a need exists for a series of water resource models-describing development, use and management functions. Studies were initiated on the cost and benefit of various elements of water resource development. Some of the studies completed are as follows: costs of reservoirs in Illinois, costs of wells and pumps, water transmission costs, costs of pumping water, and cost of sewage treatment. It is necessary to develop working tools in order to progress in the creation of a water resource use, development and management model. It is in-

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tended that these tools be used as a basis for comparison between alternatives. The results will have the same degree of certainty as incorporated in the basic cost data. Cost estimates derived by these techniques should not take the place of detailed estimates prepared by engineers for specific conditions. Cost estimates for reservoirs, wells and pumps, transmission lines, pumping water, water treatment, and sewage treatment will be helpful in linking quality, quantity and economic parameters to the physical system. Through their application, it should be possible to examine the alternative solutions to meet the objective determined by economic, social and political criteria. (Poertner) W71-04679

LINEAR PROGRAMMING APPLIED TO MULTI-STAGE CAPACITY EXPANSION OF WATER TREATMENT-DISTRIBUTION SYSTEM.

Illinois Univ., Urbana. Dept. of Business Adminis-

For primary bibliographic entry see Field 05F. W71-0473

MINIMIZING ABATEMENT COSTS OF WATER POLLUTANTS FROM AGRICULTURE: PARAMETRIC LINEAR PROGRAMMING APPROACH,

Iowa State Univ., Ames. Dept. of Economics.

E. E. Seay, Jr.
PhD Thesis, 1970. 156 p, 25 tab, 6 fig, 115 ref, 2 append. OWRR Project B-015-IA (1).

Descriptors: *Sediment control, *Water pollution control, Cost analysis, Cost repayment, Institu-tions, Water quality. Identifiers: *Pollution charges, Effluent charges.

The study focuses upon suspended sediment from agricultural lands as an example of nondegradable, diffuse source pollutant. After considerable discussion of externalities and public goods, the author comes to the conclusion (1) that 'the tax-bounty solution for dealing with external effects' is invalid, and (2) that the cost-benefit analysis is inapplicable to the study of pollution abatement because it is a public good. Therefore his major analysis is a cost effectiveness study, assuming that exogenously specified water quality criteria represent indicators of societal preferences. The Nishnabotna River Basin, Iowa, is used as the study area. By changing the quality level constraints, least-cost estimates of achieving successively higher quality standards are obtained. In order to share costs of abatement measures, a basin-wide management authority appears best. The author casts doubt upon the frequently asserted principle that the polluter should pay costs, although no disproof of this position is offered. (Whipple-Rutgers)

THE USE OF SUBSIDIES FOR WASTE ABATE-MENT,

Clemson Univ., S. C.

H. H. Macaulay.

In: Economics of Air and Water Pollution, Water Resources Research Center, Virginia Polytechnic Institute, Blacksburg, Va., p 56-73, Oct 1969.

Descriptors: Decision making, *Resource allocation, Economic efficiency, Public benefits. Identifiers: *Effluent charges, *Subsidies.

The difficulty in finding solutions to water pollution problems such as have been found for conflicting land use demands stems from cultural lag, uncertainties over ownership and legal rights, and externalities. There must be some level of water quality at which the total level of satisfactions of society will be greatest. The question is how to achieve this level of satisfactions. (The author does not discuss how to measure such satisfactions.) The means available are taxes, subsidies and regulations. Arguments in favor of the method of subsidies mostly are based upon equity, those against subsidy mostly

concern efficiency, since subsidies may encourage non-optimal over production of the goods concerned. Subsidies could be given in the form of accelerated depreciation, tax credits, and indirect assistance through government assistance to municipal plants handling industrial wastes. (See also W71-04739) (Whipple-Rutgers) W71-04743

SYSTEMS ANALYSIS FOR URBAN WATER MANAGEMENT, Water Resources Engineers, Inc., Walnut Creek.

Available from NTIS as PB-197 677, \$3.00 in paper copy, \$0.95 in microfiche. Completion Report, September 1970. 78 p, 12 fig, 9 tab, 46 ref, 1 append. OWRR Project C-1536 (No 1992) (4).

Descriptors: *Systems analysis, *Water management (Applied), *Simulation analysis, *Mathematical models, Storm runoff, Municipal water, Economics, Cities, Urbanization.

The major purpose of this study was to indicate that the goals of urban water management, with respect to the use and further development systems analysis tools explored, are attainable. It was primarily a technicalenterprise to demonstrate that a comprehensive model could be constructed in a general enough format to allow its application to many urban water systems while at the same time urban water subsystem submodels, comprising the larger model, could be operated independently to describe behavior of specific urban susbystems. Economic aspects were also considered. A comprehensive simulation model was developed for a specific hypothetical Urban Water Resources System structured to indicate the interrelationships among inflows, storage volumes, outflows, and qualities in various subsystems. A more expensive but more refined storm water modeling project was described. An economic systems model was formulated to evaluate physical works projects intended to meet urban water objectives subject to technical and budgetary constraints. Results of the hypothetical demonstrations of the technical and economic models were given. Major conclusions and recommendations were presented. (Kriss-Cornell) W71-04755

SYSTEMS ANALYSIS FOR GREAT LAKES WATER RESOURCES.

Ohio State Univ., Columbus. Water Resources

Available from NTIS as PB-197 678, \$3.00 in paper copy, \$0.95 in microfiche. Proceedings of the Fourth Symposium on Water Resources Research of the Ohio State University, Water Resources Center, October 1969. 135 p, 10 fig, 18 tab, 52 ref, 2 append. OWRR Project A-999-OHIO

Descriptors: *Systems analysis, *Water resources development, *Optimization, *Great Lakes, Pollution abatement, Economics, Ohio, Water pollution

The Symposium was an outgrowth of interest in pollution abatement measures for the Great Lakes. It represented an effort to resolve the optimum approach to be taken in the solution of water problems. Section I dealt with the biologicalchemical-physical subsystem and included development of a comprehensive simulation model of the fish resources of the Great Lakes, microbialchemical interactions as systems parameters for Lake Erie, an oxygen-based performance model for Western Lake Erie, and preliminary policy models for Great Lakes regulation. The economic subsystem was dealt with in Section II which described an interindustry forecasting model with water quality and quality constraints, some deter-minants of Detroit's regional share of economic activity in selected industries, a regional trade and structure model for pollution abatement in the Western basin of Lake Erie. Section III entitled 'Integration of the Model' included the topics of the utility of systems analysis in estuarine water quality management, and systems analysis, water quality and government decision making. (See also W71-04757 thru W71-04766) (Kriss-Cornell) W71-04756

DEVELOPMENT OF A COMPREHENSIVE SIMULATION MODEL OF THE FISH RESOURCES OF THE GREAT LAKES, Washington Univ., Seattle, Center for Quantitative

Science in Forestry, Fisheries and Wildlife. Gerald J. Paulik

In: Systems Analysis for Great Lakes Water Resources, p 11-20, October 1969. 10 p, 7 ref. OWRR Project A-999-OHIO (3).

Descriptors: *Simulation analysis, *Model studies, *Fisheries, *Fish management, Project planning, Great Lakes, Economics, Decision making, Lakes.

A continuing series of simulation models for use as basic planning devices by fisheries management agencies was proposed. The models developed would be open-ended, modular and evolutionary. Although these models would be for managing fisheries, major sectors of the lacustrine ecosystem as well as regional economics would be included as integral parts. First in the discussion was a description of the characteristics of fisheries, especially those of the Great Lakes. Then general characteristics of a simulation model for management agencies, which would provide an easily used accounting system, and experimentation with short-range and long-range effects of management policies, were given. For a model building program, it was suggested that various government agencies involved in fishery resources of the Great Lakes form in conjunction with a group of universities with model building expertise a consortium to construct a series of large-scale simulation models of the Great Lakes fisheries. During the first few years of the model building program, the uses of the models would be: (1) to serve as a data bank and line atlas; (2) to aid decision makers in evaluating tactical alternatives; and (3) to help assign priorities to basic research projects. (See also W71-04756) (Kriss-Cornell) W71-04757

SOME MICROBIAL-CHEMICAL INTERAC-TIONS AS SYSTEMS PARAMETERS IN LAKE ERIE.

Ohio State Univ., Columbus. Microbial and Cellular Biology.

P. R. Dugan, J. I. Frea, and R. M. Pfister.

In: Systems Analysis for Great Lakes Water Resources, p 21-28, October 1969. 8 p, 2 fig, 16 ref. OWRR Project A-999-OHIO (3).

Descriptors: *Systems analysis, Data collections, *Algae control, *Lake Erie, Biochemical oxygen demand, Bacteria, Ecology, Water pollution effects, Lakes, *Cyanophyta, *Eutrophication, Water quality.

Some microbial-chemical interactions as systems parameters in Lake Erie were presented. One of the major problems cited was the increased growth rate of blue green algae and other microorganisms in the lake which have led to objections because of decreased recreational value, mortality of fish and domestic animals, clogging of water supply intake filters, and depletion of oxygen in the water. Four general parameters were considered in relationship to accelerated growth of blue green algae: (1) amount of light (energy); (2) nitrogen supply; (3) CO2 or CO3; and (4) minerals. Several observations were made from data collected in the western basin of Lake Erie during the spring and summer of 1969. Using BOD as an example of recycling, role of bacteria in making nutrients available for algae growth was shown significant; and algae, once above a critical concentration significantly enrich their own environments with organics, which in-

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dicated a spiraling increase in rate of eutrophication. Suggestions for decreasing algae and bacteria population in the lake were: preventing organic and mineral nutrients from entering the water column and removing sediments of relatively high organic content physically or allowing them to decrease naturally. (See also W71-04756) (Kriss-Cornell) W71-04758

DEVELOPMENT OF AN OXYGEN-BASED PER-FORMANCE MODEL FOR THE WESTERN LAKE ERIE PHYSICO-BIOLOGICAL SYSTEM, Ohio State Univ., Columbus. Dept. of Microbiolo-

C. I. Randles, T. Y. Li, K. S. Shumate, and S. Stollmack.

In: Systems Analysis for Great Lakes Water Resources, p 29-35, October 1969. 7 p, 1 fig. OWRR Project A-999-OHIO (3).

Descriptors: *Systems analysis, *Mathematical models, *Oxygen, Data collections, *Lake Erie, Organic loading, Social aspects, Economics, Lakes, *Input-output analysis, Water quality.

A performance model for the western Lake Erie physico-biological system that will provide a sound base for determining the 'best' uses of the system in a socio-economic sense using a systems analysis approach was proposed. Mathematical modeling of processes in the basis, or submodels of the system, provided the basis for selecting significant parameters, via quantitized analyses, included in the overall system model. Oxygen provided the best combination of characteristics needed for the common measure of performance of the system because of its usability, inclusiveness, and scientific soundness. Major inputs, outputs, processes and influencing factors for measuring the state and changes in state of the physico-biological were illustrated and general comments were made about the system. Two special cases, one where there were no inputs or outputs of either organic materials or oxygen (a closed system), and one where the system is in a steady state (inputs and outputs of oxygen and organic materials were balanced) were mentioned although could not be used for western Lake Erie. Specific data needed for the conceptual model were: organic and oxygen inputs in influent rivers; organic and oxygen outputs to central basin; organic inputs or outputs to sediments, organic outputs in the form of fish, insects, algae, etc., oxygen inputs from or outputs to the atmosphere; and photosynthesis and respiration. (See also W71-04756) (Kriss-Cornell)

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PRELIMINARY POLICY MODELS FOR GREAT

LAKES REGULATION, Cornell Univ., Ithaca, N.Y. Dept. of Water Resources Engineering. Daniel P. Loucks.

In: Systems Analysis for Great Lakes Water Resources, p 37-45, October 1969. 9 p, 1 fig, 6 ref. OWRR Project A-999-OHIO (3).

Descriptors: *Stochastic processes, *Mathematical models, *Optimization, *Great Lakes, *Regulated flow, Short-term planning, Long-term planning,

Identifiers: Policy models.

Development of preliminary models to partially regulate lake levels and outflows of the Great Lakes were proposed. First some discussion of the existing regulation policy was useful for un-derstanding potential and limitations of future increased regulation. The general interest groups affected by variations in lake levels and outflows were said to be shore property or riparian interests, navigation interests, and power interests. The first set of policy models examined were for defining alternate short-run policy functions and the second set were for long-run policy models. These stochastic optimization models for defining policies could be jointly used to effectively define and evaluate Great Lakes regulation policies. Short-run policies for the entire lake system would be restricted to indicating how much to release from Lake Superior (most upstream lake) and Lake Ontario (most downstream lake), and how much to divert into and/or from each of the lakes, in order to minimize the expected loss resulting from deviations from the target range of lake levels and outflows. The long-run models would specify not only the preliminary operating policy but also the targets and capacities that together with the policy achieves the objective. (See also W71-04756) (Kriss-Cornell) W71-04760

AN INTERINDUSTRY FORECASTING MODEL WITH WATER QUANTITY AND QUALITY CONSTRAINTS,

West Virginia Univ., Morgantown. Dept. of William Miernyk.

In: Systems Analysis for Great Lakes Water Research, p 49-58, October 1969. 10 p, 1 fig, 7 ref. OWRR Project A-999-OHIO (3).

Descriptors: *Input-output analysis, *Leontief models, Constraints, *Water quality, *Water supply, *Colorado River Basin, *Forecasting, Economics, Industries, Water pollution control.

A method used to make long-range projections of economic activity in the Colorado River Basin with water quantity and quality constraints was described. Six sets of projections were made, one for each sub-basin of the Colorado River Basin, with 1980 and 2010 as the target years. The forecasting model was the conventional open Leontief input-output model with changing input coefficients. Separate transaction tables were constructed for each of the six sub-basins, with 1960 as the base year. Non-agricultural and agricultural data were collected and linked together by balancing import rows and export columns, the result being a 'pure' interregional interindustry model. A flow diagram of the computational procedures, which involved eleven steps for input-output projections, was shown. Two sets of projections were completed, one for water quality only and the other involving both quantity and quality constraints. Three general illustrative cases, for agricultural sectors, commercial and industrial users, and municipal users, were sketched. In order to measure damages due to water quality degradation, total gross output as given by the quantity constrained projections, minus total gross output in the qualityconstrained projections was used. (See also W71-04756) (Kriss-Cornell) W71-04761

SOME DETERMINANTS OF DETROIT'S RE-GIONAL SHARE OF ECONOMIC ACTIVITY IN SELECTED INDUSTRIES,

Wayne State Univ., Detroit, Mich. Dept. of Economics.

John Mattila.

In: Systems Analysis for Great Lakes Water Resources, p 59-73, October 1969. 15 p, 10 tab, 1 append. OWRR Project A-999-OHIO (3).

Descriptors: *Regional analysis, *Taxes, *Industrial production, Income, Growth rates, Correlation analysis, Regression analysis, Michigan, Costs, Industries.

Identifiers: *Detroit.

The impact of additional taxes in conjunction with wages, interest and capital investment, on changes in income and employment for selected industries in the Detroit metropolitan area, possibly because of the cost of fighting water pollution, was examined. These industries, the major exporters of the area, included: motor vehicle, machinery, fabricated metals and primary metals. The dependent variables in the model were the national growth component, the industry-mix component (difference between industry's national growth rate and overall national growth rate), and the regionalshare component (difference between industry's

national and local growth rates). These variables were expressed in terms of income or employment gained or lost as a result of differential growth rates. Total state and local taxes and total property taxes collected annually in Macomb, Oakland and Wayne counties were used as the two alternative tax variables. Simple correlation coefficients between regional share variables devuldged some agglometation relationships existing among Detroit's export industries. From these regression coefficients, first approximations to state and local tax impact multipliers were computed. This approach demonstrated considerable year-to-year variation in state and local taxes in Detroit relative to state and local taxes in the rest of the nation. (See also W71-04756) (Kriss-Cornell) W71-04762

REGIONAL TRADE AND STRUCTURE MODEL FOR POLLUTION ABATEMENT STUDY,

Ohio State Univ., Columbus. Dept. of Economics. Richard T. Stillson.

In: Systems Analysis for Great Lakes Water Resources, p 75-89, October 1969. 15 p, 2 fig, 1 append. OWRR Project A-999-OHIO (3).

Descriptors: *Optimization, *Simulation analysis, *Model studies, Regional analysis, *Pollution abatement, Economics, Lake Erie, Costs, Constraints, Lakes, Water pollution control, Water

Outlines of a regional trade model useful in determining the likely economic impact of various proposed pollution abatement programs for the Western Basin of Lake Erie were presented. The model was designed to analyze the likely economic impact of implementation of 'The Lake Erie Report: A Plan for Water Pollution Control' which proposed several abatement programs including construction for sewers, secondary and tertiary treatment facilities of municipal waste and enforcement of a high standard of industrial treatment facilities. Interregional activity analysis was broken down for each region into: (1) production of final products, (2) production of intermediate products and (3) shipment of every commodity from each region. A sample input-output matrix of such activities was shown. This activity analysis was used to formulate a programming model to allocate given resources among activities. The variable maximized was the gross return to regional resources and to shipping. The four constraints on the activity levels were: (1) material balances, (2) final resource constraints, (3) capacity constraints, and (4) non-negativity constraints. The model was used to simulate short run impact of abatement programs with four major effects on a regional economy: (1) taxation effect, (2) water input effect, (3) industrial control effect, and (4) abatement as a user of resources. The model was to be simulated for the Detroit-Toledo area using inputoutput coefficients for 1963. (See also W71-04756) (Kriss-Cornell) W71-04763

TRADE STUDY RELEVANT TO POLLUTION ABATEMENT IN THE WESTERN BASIN OF LAKE ERIE,

Ohio State Univ., Columbus. Dept. of Economics. Thomas C. Webster.

In: Systems Analysis for Great Lakes Water Resources, p 91-110, October 1969. 10 p, 7 tab. OWRR Project A-999-OHIO (3).

Descriptors: *Regional analysis, *Pollution abatement, *Lake Erie, Industrial production, Data collections, Statistics, Lakes, Water pollution control, Costs, Water quality. Identifiers: *Trade study.

Data, which will provide a description of those industries important to the economy of the Western Basin and engaged in regional trade for use in the Regional Trade Study of the Western Basin of Lake Erie, was given. The geographic area constituting the industrial sector of the Western Basin was

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defined as the metropolitan areas of Detroit and Toledo. Industries included in the model were assumed to have similar technologies and therefore be affected by pollution abatement programs in similar ways. In Table 1, these industries were classified according to the Standard Industrial Classification (SIC) system and a description of each provided a breakdown of the various products they produce. Table 2 listed data for the adjusted value added by manufacturing for each selected or major industry group in the Detroit-Toledo SMSA and the percentage of the total value added by manufacturing for each selected industry. The distance which the commodities produced by the various in-dustries are transported, as given by the '1962 Census of Transportation' was given in Table 3. Table 4 showed the degree of concentration of the various industries within the fifteen largest producing regions for each industry. Aggregates that will be used in the regional trade model were shown in Table 5. Adjusted values added by each industry and percentage of the total value added to each industry aggregation were given in Tables 6 and 7 respectively. (See also W71-04756) (Kriss-Cormell) W71-04764

THE UTILITY OF SYSTEMS ANALYSIS IN ESTUARINE WATER QUALITY MANAGE-

Manhattan Coll., Bronx, N.Y. Dept. of Civil En-

gineering. Robert V. Thomann.

In: Systems Analysis for Great Lakes Water Resources, p 119-128, October 1969. 10 p, 2 fig, 1 tab, 8 ref. OWRR Project A-999-OHIO (3).

Descriptors: *Systems analysis, *Mathematical models, Water quality, *Waste disposal, Optimization, Fish management, Dissolved oxygen, Delaware River, Estuaries, Water pollution con-

Identifiers: Non-steady state model, *Delaware estuary.

Several approaches used to synthesize some major features of the fields of sanitary engineering, limnology, hydrodynamics, ecology, and operations research into a unified methodology of water quality management were discussed. The basic objectives of the analytical framework were to: (1) determine underlying casual relations between waste discharges and water quality; (2) develop methods of forecasting water quality on long-term and short-term basis; (3) analyze interactions between water quality and water use; and (4) develop methods and guidelines for optimal management. Equations were developed which expressed the cause and effect relationships between input, such as waste discharge, and output, such as dissolved oxygen. A systems approach was applied to water quality problems of the Delaware Estuary in the area from Trenton, New Jersey to Liston Point, Delaware. The survival of anadromous fish, mostly the American shad, was cited as an example of the effect of discharge of municipal and industrial wastes resulting in poor water quality. A nonsteady state mathematical model was developed with dissolved oxygen as the indicator variable. A Runge-Kutta approximation was used to numerically integrate sets of equations. Using a survival function and arrival times of fish, an average percent survival of the total population was estimated. Implementation of this program to the Delaware Estuary was described. (See also W71-04756) (Kriss-Cornell) W71-04765

SYSTEMS ANALYSIS, WATER QUALITY AND GOVERNMENT DECISION MAKING, New York State Dept. of Health, Albany. Environ-

mental Health Services. Leo J. Hetling, and Dwight Metzler.

In: Systems Analysis for Great Lakes Water Resources, p 129-135, October 1969. 7 p, 1 fig, 9 ref. OWRR Project A-999-OHIO (3).

Descriptors: *Systems analysis, Water quality, *Decision making, *Governments, Management, Economics, Technology, Surveys, Water pollution

Identifiers: Potomac River Basin.

Inter-actions between systems analysis, water quality and government decision making were considered not quantitatively, but based on a subjective interpretation. The method utilized was to examine the relationships implied via a case study of a presently pertinent water quality problem watershed—'The Potomac River Basin'. The proposal model was arbitrary, subjective and nonquantitative. Government was divided into four distinct sectors of activities--Management, Technical Analysis (socio-economic-engineering), Surveillance and Implementation. Actual water quality situations of the Potomac were fitted into the four sectors of the proposed structure. From the case study it appeared that: (1) systems analysis was more predominant in technical studies and surveillance than in governmental activities; (2) little use of these methods have been made by management and in implementation; (3) no attempt was made to utilize the method for the entire system; and (4) detailed technical studies are not utilized in decision making. (See also W71-04756) Kriss-Cornell) W71-04766

EFFECTS OF AXIAL DISPERSION ON THE OP-TIMAL DESIGN OF THE ACTIVATED SLUDGE

Kansas State Univ., Manhattan. Dept. of Chemical

Engineering.
For primary bibliographic entry see Field 05D.
W71-04768

APPLICABILITY OF **SHORT-MEMORY** MODES TO ENGLISH RIVER-FLOW DATA, Birmingham Univ. (England).

N. T. Kottegoda.

Institution of Water Resources Engineers Journal, Vol 24, No 8, p 481-489, November 1970. 9 p, 8

Descriptors: *Mathematical models, *Time series analysis, *River flow, Statistics, Annual, Monthly. Identifiers: *Hurst phenomenon.

A mathematical model for time-series of river flows was undertaken in order to predict the characteristics of future water supplies as a pre-requisite to the planning of water resource projects. In this first stage several statistical tools, such as the range covariance, and special analysis, were used to examine the structure of river-flow records. Three separate estimates of an exponent H (the Hurst phenomenon), which is expected to lie in the range 0.5 to 1.0 and is a measure of the steadiness of the river flows, were made for these five rivers: Elan Valley, River Severn at Bewdley, the Alwen, the Brenig, and the River Derwent at Yorkshire Bridge. Initially, annual values used for the analysis and results in respect to two of the catchments were shown (Elan Valley and River Severn at Bewdley). A biassed value of H seemed to be propagated by annual values and therefore a rescaled range of monthly flows was made and range diagrams were provided. The effects of cycles and the slopes of spectral diagrams gave the other estimates of H. H provided a critical factor in determining the best type of model with predictability of river flows decreasing as H increased. (Kriss-Cornell) W71-04770

THE FINITE DAM II,

gineering.

Western Australia Univ., Nedlands. For primary bibliographic entry see Field 08A. W71-04771

DIGITAL COMPUTER SIMULATION OF WASTE TREATMENT PLANTS USING THE WATCRAP-PACER SYSTEM, Waterloo Univ. (Ontario). Dept. of Chemical EnFor primary bibliographic entry see Field 07C. W71-04772

INTRA-YEAR WATER STORAGE.

Arta (Greece)

For primary bibliographic entry see Field 04A. W71-04773

MATHEMATICAL MODEL FOR WATER-WASTE WATER SYSTEMS,

Bechtel Corp., San Francisco, Calif. Scientific Development Dept.

For primary bibliographic entry see Field 05D. W71-04774

MATHEMATICAL MODEL FOR WATER DISTRIBUTION SYSTEMS.

Arya Mehr Industrial Univ., Tehran (Iran) For primary bibliographic entry see Field 08B. W71-04775

WATER REUSE SYSTEMS ANALYSIS,

Institute for Water Resources (Army), Alexandria, Va.; and Colorado State Univ., Fort Collins. Dept.

of Civil Engineering.
For primary bibliographic entry see Field 05D.
W71-04778

ECOLOGICAL MODELING RESEARCH IN

THE GREAT LAKES,
Michigan Univ., Ann Arbor. Dept. of Wildlife and Fisheries; and Michigan Univ., Ann Arbor. Dept. of

Civil Engineering.

James T. McFadden, and John M. Armstrong.

Shore and Beach, Vol 38, No 2, p 17-25, October 1970. 9 p, 6 fig, 1 tab.

Descriptors: *Systems analysis, *Mathematical models, *Ecology, *Great Lakes, *Water resources development, Decision making, Planning. Identifiers: *Socio-economic problems, *Grand Traverse Bay.

The University of Michigan's Sea Grant Institutional Support Program, a multidisciplinary program begun in July 1969, was described as an experiment in the mobilization of resources of an educational institution to deal more effectively with current societal-environmental problems. Using a systems approach, the exploration of resource development alternatives was carried out through manipulation of predictive models of the marine resource system and the directly inter-locking portion of the socio-economic system. Eight integrative functions were used to deal comprehensively with the problems and opportunities arising from the six major resource attributes of the Great Lakes: lake levels; water quality and circulation; plants and animals produced; size, depth and minerals of basin; unique character and configuration of shoreline; and regional, climate. In order to approach this long-term resource-planning objective, the Grand Traverse Bay was selected as the focus of pilot efforts to develop a complete model of a small part of the Great Lakes ecosystem. The predictive model was developed through a set of 'specific process sub-models' which generated the interactions or transfer process among the components of the system and interfaced with one another in a complex pattern. To provide data needed to develop these models, twelve field research projects were initiated. (Kriss-Cornell) W71-04780

MARINE RESOURCES PLANNING AND MANAGEMENT FOR NASSAU AND SUFFOLK COUNTIES, LONG ISLAND, NEW YORK, Nassau and Suffolk Counties, N.Y. Phillip B. Cheney, and Robert H. Ellis. Marine Technology Society, Journal, Vol 4, No 2, p 50-55, March-April 1970.

Descriptors: *Water Resources, *Environment, *Planning, *Management, Coasts. Identifiers: Long Island.

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A joint project for the research and development of a system for marine environment and resources management of Long Island has been undertaken by Nassau and Suffolk Counties. The first phase of the program is discussed and the marine environment related problems of Long Island are considered. (Ensign-PAI) W71-04837

6B. Evaluation Process

A WILD AND SCENIC RIVERS SYMPOSIUM. Idaho Univ., Moscow. Water Resources Research

Available from NTIS as PB-197 527, \$3.00 in paper copy, \$0.95 in microfiche. Herbst, John R. and Michalson, Edgar L., editor. Idaho University Water Resources Research Institute Information Bulletin No 6, August 1970. 41 p, append. OWRR Project No B-014-IDA (1).

Descriptors: *Wild rivers, *Natural streams, *Natural resources, *Water resources, *Idaho, Aesthetics, Scenery, Preservation, Wild River Act, Water policy, Surface waters, Planning, Water utilization, Wildlife conservation, Fish conservation tion, Water control, Conferences

Identifiers: *Wild and scenic Rivers symposium

This paper discusses the viewpoints of people of varied backgrounds and interests on the subject of wild and scenic rivers as expressed at the Wild and Scenic Rivers Symposium held at Salmon River Lodge, Idaho, July 25-27, 1969. The discussion covers most of the main points of wild rivers, from the plea to save some rivers for posterity to the developmental opportunities that rivers afford. Several conclusions were drawn from the Symposium. First, the 'Wild and Scenic Rivers Act' enacted by Congress is not a water project development act, but because there is some question as to development opportunities it was suggested that benefits foregone should be measured. A method to indicate the importance of aesthetic values should be developed, and the problem of identifying aesthetics needs resolved. Emphasis should be placed on alternative methods of wild and scenic river evaluation. This is a broader problem than just economics or engineering. Education of the public in terms of wild and scenic rivers is needed, as well as providing means for the public to express (See also W71-04420) their preferences. (Woodard-USGS) W71-04419

A METHODOLOGY STUDY TO DEVELOP EVALUATION CRITERIA FOR WILD AND SCENIC RIVERS,

Idaho Univ., Moscow. Water Resources Research Inst.

Fred I. Watts

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Water for Municipal and Industrial Use Subproject, Report, Water Resources Research Institute, Aug, 1970. 39 p, 19 tab, 4 ref, 1 fig. OWRR Project B-014-IDA (2).

Descriptors: *Wild rivers, Municipal water, Indus-Identifiers: Public Law 90-542, Salmon River, Idaho Economic Base Study for Water Requirements, National Wild and Scenic Rivers System.

The Scenic Rivers Study Unit of the Water Resources Research Institute at the University of Idaho is attempting to identify valid criteria for evaluating rivers for wild or scenic classification. By studying the economic, aesthetic, scenic and other values of the Salmon River in Idaho, the study unit hopes to establish a methodology for planning the selection, use and management of wild and scenic river systems. The study of the Salmon River has been divided into eleven subprojects, each related to one of the resource or service functions of the river. This subproject on the municipal and industrial uses of the Salmon River attempted to catalogue this information for the present as well as future employment and population conditions up until the year 2020. (See also W71-04419) (Holmes-Rutgers) W71-04420

IMPACT OF IRRIGATION DEVELOPMENT ON INCOME AND TRADE, EASTERN AND CEN-TRAL SOUTH DAKOTA,

South Dakota State Univ., Brookings. Dept. of Economics.

For primary bibliographic entry see Field 03F. W71-04421

THE SUSQUEHANNA COMMUNICATION-PAR-TICIPATION STUDY: SELECTED APPROACHES TO PUBLIC INVOLVEMENT IN WATER RESOURCES PLANNING,

Institute for Water Resources (Army), Alexandria, Va.; and Michigan Univ., Ann Arbor.

Thomas E. Borton, Katharine P. Warner, and J. William Wenrich.

IWR Report 70-6, Dec 1970. 128 p, 44 ref.

Descriptors: *Planning, *Community development, *Urbanization, *Institutions, Social aspects, Social values.

Identifiers: *Public participation, Citizen involvement in planning, Survey questionnaires, Community planning.

This research was conducted by the Environmental Simulation Laboratory and the Institute for Social Research of the University of Michigan. The study represents an effort to introduce and evaluate selected approaches to public involvement in the Susquehanna River Basin Study. The public involvement activities centered upon establishing a program of lined contacts between agency planners and local residents. Some of the important activities were identification and interviews with local opinion leaders, mailing of brochures, newsletters, and surveys, and workshops and forum meetings. Questionnaires were used throughout the study to evaluate changes in attitudes and the effectiveness of the techniques used. The findings indicate that the workshops were particularly successful in improving the understanding of attitudes and objectives between the agency planners and local representatives. The research evolved a public participation process model indicating the relation of public involvement to the phases of planning. (See also W71-04424) W71-04423

PUBLIC PARTICIPATION WATER RESOURCES PLANNING,

Institute for Water Resources (Army), Alexandria,

A. Bruce Bishop.
IWR Report 70-7, Dec 1970. 109 p, 27 ref.

Descriptors: *Planning, *Community development, *Urbanization, *Institutions, Social aspects, Social values, Social change. Identifiers: Public participation, Planning

methodology, Community planning, Decision-mak

Public concern over the use of the nation's natural resources has led to increased citizen participation in the public works planning process. This report focuses on the development of water resources in relation to the role of the planner in communicating and interacting with the publics in planning. It describes the institutional and behavioral aspects of planning as a process of social change, offers a descriptive model of the planning process, and with this as a framework discusses methods and approaches for developing public participation in planning studies. Six public participation program objectives are set forth to guide the organization of citizen involvement in planning studies. Initially, the planners should identify concerned local interests and establish working relationships with them in order to legitimize the study. A number of methods for working with the public are described, including information campaigns, sample surveys, group advocacy, informal contact with local in-terests, community workshops, citizens' commit-tees, special task forces, public inquiries, and public hearings. The use of a factor profile is discussed as a method for presenting, discussing and evaluating the social, environmental and community effects, together with the economic effects of alternative planning proposals. (See also W71-W71-04424

REGIONALIZATION IN THE CONTEXT OF MULTIOBJECTIVE PLANNING AND EVALUA-TION.

Institute for Water Resources (Army), Alexandria, Va.

L. G. Antle, and R. J. Struyk. Center for Economic Studies, Paper 70-2, October 1970. 17 p.

Descriptors: *Regional analysis, *Cost-benefit analysis, *Decision making, *Economic justification, Feasibility, Social aspects.

This paper comments on the July 1970 draft of 'Procedures for Evaluation of Water and Related Land Resources Projects', the new multiple-objective planning process which is under consideration by the Water Resources Council. The paper accepts the basic philosophy of the new procedures, but points up certain problems especially concerning the choice of regions to display information required under the new procedures. In particular, it is necessary that off setting impacts not be concealed, so that area affected differently should not be consolidated into one region. This is important for secondary as well as primary benefits. The authors comment upon action of the office of Business Economics, Department of Commerce (OBE) which is preparing estimates of economic impacts by region for this and other purposes. Differences in defining planning regions for natural resource programs and for urban-oriented programs is particularly important. The OBE regions will be based upon city regions each with its hinterland. As far as possible Standard Metropolitan Statistical areas SMSA) are to be used. The authors point out that the analytical purposes of the OBE regions will often not correspond to the 'project regions' or to the 'displacement regions' within which influences such as project employment and project visitation are important. Formal defining of displacement regions is an important step, which however is not so far required under the proposed new procedures. (Whipple-Rutgers) W71-04447

DISCUSSION OF DRAFT REPORT PROCEDURES FOR EVALUATION OF WATER AND RELATED LAND RESOURCES PRO-JECTS,

New York State Dept. of Conservation, Albany. Div. of Water Resources.

Nicholas L. Barbarossa.

Presented at third Annual Conference of Federal and State Officials, Salt Lake City, June 24, 1969.

Descriptors: *Cost-benefit analysis, *Decision making, *Social aspects, *Environment, Benefits, Direct benefits, Economic efficiency, Economic justification, Feasibility, Natural resources, Value, National income, Regional analysis.

This is a critique of a 1969 draft of the new Water Resources Councils proposals for multiple objective planning. The new principles propose that national income, instead of being the prime objective as previously, shall be only one of four objectives of which three deal with social, environmental and regional objectives. The author objects strongly to these proposed new principles because in his view the change is still insufficient. He would burn the bridge to the past and abandon the benefit cost approach altogether. He considers that national in-

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come should not be a stated objective, and should be replaced by a general objective 'to develop the most promising water resources projects at least cost to serve the many needs of the people.' Among other views of the author, he opposes the opportunity cost approach to government discount rate ('ridiculous'), and the view that secondary benefits should be ignored because they will generally cancel out ('academic hash'). He considers that secondary benefits would be very much greater in the northeastern United States than in other regions. (Whipple-Rutgers) W71-04448

THE EVALUATION OF METHODS USED IN EVALUATING RECREATIONAL BENEFITS OF MULTIPLE-PURPOSE WATER RESOURCE PROJECTS.

Hubert Hinote.

Navigation Economics Branch, Division of Navigation Development, Tennessee Valley Authority, Knoxville, Tennessee, August, 1967. 81 p.

Descriptors: *Outdoor recreation, *Economic evaluation, *Benefits, *Costs, Prices, Demand, Income, Economic efficiency, Data acquisition, Water resource development, Management, Decision-making, Multiple-purpose projects, Supply. Identifiers: *Market value, *Consumer's surplus, Value added, Alternative costs, Travel costs.

In this paper the author reviews and summarizes the efforts that have been made to determine the recreational benefits from multiple-purpose water resource projects in order to provide a means of guiding social choice. Water has traditionally been treated as a free good and only recently has a value been attached. It has become necessary to establish a criterion of value and to measure the resource inputs to outdoor recreation by that criterion. The most commonly used method of evaluation of the recreational benefits of public projects has been the market value method. Due to the weaknesses involved, however, a number of other approaches are considered. These include evaluation of the gross or net expenditures for recreation, the induced impact of recreation on productive efficiency, the costs of recreational facilities, and the demand curve for recreation activities. The author concludes that the use of the imputed recreation demand curves is most promising but research is needed on (1) the factors effecting demand, (2) the data problems involved, (3) the substitution of travel costs for price, (4) exactly who receives the benefits, (5) the impact of the supply of recreational opportunities, and (6) the impact of particular management plans upon project benefits. (Murphy-Rutgers) W71-04449

ADMINISTRATIVE ECONOMIC AND ADMINIST PROBLEMS OF WATER POLLUTION,

Oregon State Univ., Corvallis.

Emery N. Castle.

In: Agriculture and the Quality of Our Environment, Norwood, Massachusetts, The Plimpton Press, p 251-265, 1967.

Descriptors: *Water quality, *Economic evalua-tion, *Recreation, *Water pollution, Management, Waste disposal, Marginal costs, Decision-making, Stream rivers, Government, Cost-benefit analysis, Measurement, Investment.

Identifiers: *Externalities, *Economies of scale, *Extra-market values, *Market failure, Jaquina River, Oregon.

Technical interdependence in production and consumption processes creates a situation in which the level of water quality cannot be determined by the market. The author finds that the least costly method of achieving a given level of water quality requires group action. As an aid to this group deci-sion-making, economic evaluation studies are extremely useful. The paper reports on a study of the western part of Oregon surrounding the estuary of the Jaquina River. It was found that the tools exist

for quantifying recreational and secondary benefits and that sequential process analysis is largely inadequate for making long-run economic projections. The author states that, if adequate institutional arrangements could be developed, communities or regions could have considerably more flexibility in the allocation of both the costs and benefits of water quality. (Murphy-Rutgers) W71-04450

ECONOMIC GROWTH AND ENVIRONMEN-

Coe Coll., Cedar Rapids, Iowa.

John K. Chapman.

In: Man and the Quality of His Environment, Boulder, University of Colorado Press, 1968, p 231-239.

Descriptors: *Economics, *Environmental quality, *Water pollution, *Air pollution, Prices, Costs, Planning, Diseconomics of scale, Income, Population, Sewerage, Input-output, Regional analysis
Identifiers: *Economic growth, *Bou *Boulder Colorado, Externalities, Multiplier effect.

This paper presents a study of the Boulder, Colorado economy in order to point out how economic growth can create environmental problems. The major purpose of this study was to utilize input-output analysis to trace the total income and employment effects of federally funded space research and production spending by several local establishments. However, the author uses this study to analyze the problem of the external diseconomics of scale which accrue to agglomerates of people with particular attention paid to the problems of air and water pollution. The difficulties arise because both the direct and indirect effects of pollution occur outside the market system. The author separates the costs into accommodation costs which arise out of the need to accommodate more people with higher incomes and removal costs which are costs arising out of air and water pollution. In conclusion, the author sees the need for a much larger effort in this type of analysis than is presently being made. (Murphy-Rutgers) W71-04451

THE EXPOST EVALUATION OF FEDERAL WATER RESOURCE PROJECTS IN THE UNITED STATES.

Department of the Army, Washington, D.C. Jim J. Tozzi.

Organization for Economic Cooperation and Development Seminar on Expost Evaluation, the Hague, Netherlands, October, 1970. 18 p.

Descriptors: *Economic evaluation, *Cost-benefit analysis, Flood control, Income, Taxes, Government, Multi-purpose projects, Recreation, Social Navigation, Costs, Transportation,

Identifiers: *Expost evaluation, *Corps of Engineers, Income redistribution, Dewey Reservoir, Arkansas River.

Expost evaluation of water resource projects refers to the assessment of their observed effects on the natural, economic and social environment. Relying upon the experience of the United States Army Corps of Engineers the author attempts to present the technique of expost evaluations and discusses the merits of this approach. The paper also identifies and explains some of the basic analytical principles involved in expost evaluation and gives specific examples of their application in water resource projects. The discussion includes the national income and income redistribution effects of water investments. The author concludes that postconstruction evaluations are no less feasible than the usual pre-construction evaluations. (Murphy-Rutgers) W71-04452

EVALUATION METHODOLOGY OF URBAN AND REGIONAL PLANS: A REVIEW,

London Univ. (England). School of Environmental Studies

Nathaniel Lichfield.

Regional Studies, Vol 4, No 2, p 151-165, August

Descriptors: *Cost-benefit analysis, *Economic evaluation, Decision making, Linear programming, Feasibility, Systems analysis.
Identifiers: *Planning Balance Sheet, *Project ap-

praisal, Cost effectiveness, Externalities, Public sector investment, Objective function, Net benefit.

The article makes a review of methods currently used or proposed for evaluation of prospective projects. The author feels evaluation methodology should satisfy certain criteria, such as complying with stated objectives, considering all costs including externalities and all benefits in money terms and finally indicating the incidence of costs and benefits on all parts of the community. The main methodologies studied are the Planning Balance Sheet, investment appraisal, cost minimization, cost effectiveness, and cost-benefit analysis. In cost minimization, the end product is assumed constant while in cost effectiveness, the end product is variable. Linear programming is considered under cost benefit techniques. The author finds that where a cost-benefit analysis is carried out in a comprehensive manner in relation to the systems and sectors of interest, this analysis becomes a Planning Balance Sheet. Of the methods considered, only cost benefit analysis fulfils the outlined criteria and is sufficiently comprehensive. This article is relevant for water research efforts interested in comparing alternative project evaluation techniques. (Siegenthaler-Rutgers) W71-04453

POLICY MATTERS IN INVESTMENT DECI-

SION-MAKING,
International Bank for Reconstruction and
Development, Washington, D.C.

S. A. McBride.

Regional Studies, Vol 4, No 4, p 241-253, August

Descriptors: *Cost-benefit analysis, Decision-making, Economic evaluation, Interest rate, Economic efficiency, Systems analysis, Welfare economics, Budget constraint.

Identifiers: *Multiple objective function, Net benefit, Income redistribution, Opportunity cost, Externalities.

This paper proposes a benefit-cost framework that simultaneously treats multiple objectives, as well as simultaneously treats multiple objectives, as well as other matters of policy. The author attempts to illustrate the importance of policy determination in investment decision-making. The framework provides an estimate of the first round net benefits generated by the investment for multiple objectives. To simultaneously treat the objectives of economic efficiency and income redistribution, the objective function is formulated by weighting the net contribution that projects make to each objec-tive subject to constraints. It is shown that the outcome depends largely on the policy-makers state-ment of objectives, the relative values assigned to the contributions to these objectives generated by the investment and the selection of an interest rate and economic life of the project. The model does not consider the multiplier incomes generated from increased spreading by beneficiaries of the project. This article is relevant for possible application to multipurpose project evaluation. (Siegenthaler-Rutgers) W71-04454

TECHNIQUES FOR PROJECT APPRAISAL UNDER UNCERTAINTY,
International Bank for Reconstruction and Development, Washington, D.C.

Shlomo Reutlinger. World Bank Staff Occasional Papers, Number 10,

Field 06—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

Descriptors: *Cost-benefit analysis, *Uncertainty, Probability, Correlation analysis, "Oncertainty, Probability, Correlation analysis, Decision making, Risk, Feasibility, Economic evaluation.

Identifiers: *Project appraisal, *Aggregation problem, Bias, Standard deviation, Public invest-

ment, Sensitivity analysis, Rate of return, Present value, Maximum likelihood.

The primary purpose of this study is to present a feasible method for evaluating the riskiness of investment projects. A second objective is to show how quantitative evaluations of the riskiness of projects might be used in various decision problems. The emphasis is on methodology and problems of measurement. The paper recommends that the best available judgments about the factors affecting cost and benefit estimates of a project can be estimated via probability distributions. These distributions can be aggregated mathematically to yield a probability of the propagate bility distribution of the rate of return, or net present worth of the project. The author discusses the nature of uncertainty and the kind of judgments that are basic ingredients for decision-making. He singles out the probabilistic approach as most suita-ble for project appraisal. The paper considers the aggregation of probability distributions of relevant factors and parameters into a probability distribu-tions of the economic returns of a project. Case studies are used to illustrate the application of the method. This paper is relevant for the evaluation of water resource projects which have identifiable risks associated with either cost and/or benefit projections. (Siegenthaler-Rutgers) W71-04456

COST-BENEFIT ANALYSIS AND THE THEORY OF PUBLIC FINANCE,

Harvard Univ., Cambridge, Mass. Richard A. Musgrave. Journal of Economic Literature, Vol VII, No 3, p 797-806, September 1969.

Descriptors: *Cost-benefit analysis, *Economic evaluation, *Welfare economics, Financing, Investment, Decision-making, Planning, Management, Economic efficiency, Optimization, Government, Income, Rate of discount, Taxes.

Identifiers: *Public finance, *Social goods, *Opportunity cost, Distributional objectives.

This paper is concerned with the application of cost-benefit analysis to the determination of public expenditure policy and its relation to the central economic theory of social goods. It is argued that cost-benefit analysis can perform most effectively in the case of an intermediate social good. The author examines the relation between investment mix and total investment and the way in which the means of finance enter the profitability calculation.
On the problem of distributional objectives, the author argues against the inclusion of value weights into the objective function for the particular investment and instead favors a policy which combines various instruments to secure various targets. The author concludes that cost-benefit analysis, even if combined with traditional tax analysis does not provide a substitute theory of public finance. Because of the clarification of the principles behind cost-benefit analysis and the public good aspects of water resources, this article is relevant to the water researcher. (Murphy-Rutgers) W71-04461

TECHNOLOGICAL INJURY,

Blackburn Coll. of Technology and Design (England). For primary bibliographic entry see Field 06G. W71-04465

WATER POLLUTION,

Mersey and Weaver River Authority (England). C. Lumb.

In: Technological Injury, New York, Gordon and Breach, 1969, p 29-51.

*Water Descriptors: *Pollution. *Technology, Water supply, Water quality, Water demand, Rivers, Effluents, Sewage, Waste water, Pesticides, Water law, Oxygen. Identifiers: *Oil contamination, Synthetic deter-

This paper reviews the adverse effects which technological developments have had on the pollution of water and water supplies. The principle uses made of water resources are of two types: (1) abstractions from sources of supply for domestic, manufacturing, cooling and irrigation purposes; and (2) uses in site for fisheries, navigation, and recreation purposes and for the conveyance of waste effluents. After summarizing these uses the author examines some of the ways in which these may be threatened by technological developments. There is a discussion of pollution by sewage effluents, by the chemical industries, by oil refining, by metal finishing industries, by agriculture, by pesticides, and by radioactivity. For each type of pollution, the economic, social, and technological magnitude of the problem is outlined. The need for controlling pollution is discussed and the legal position of pollution control in Great Britain sum-marized. This article has relevant extensions to pollution problems in the United States. (See also W71-04465) (Murphy-Rutgers) W71-04466

PROBLEMS IN IMPLEMENTING PROGRAM BUDGETING.

California Univ., Los Angeles.

George A. Steiner. In: Program Budgeting, edited by Novick, David, Cambridge, Harvard University Press, 1967, p 308-

Descriptors: *Budgets, *Management, *Decision-making, *Government, Cost-benefit analysis, Social aspects, Planning, Political aspects, Pollution, Resource allocation, Time.

Identifiers: *Program budgeting, *Relevant alternatives, National Environmental Health Center, Magerial discretion.

This study examines the many impediments to the rapid expansion of program budgeting and longrange planning in the analysis of government projects. Program budgeting is a useful tool in water resource projects and the author's treatment of these problems should be of interest to the water researcher. The program budgeting concept is outlined and a brief history of its use is presented. Of particular interest to the water researcher is the case study of the National Environmental Health Center which was designed to study air, water and land pollution. The growing recognition of the benefits of the program-budgeting system has resulted in its adaptation in many government agencies. The system permits more rational decisions and better management by fostering a more complete analysis of alternative investment proposals. (Murphy-Rutgers) W71-04467

PROGRAM BUDGETING-APPLYING ECONOMIC ANALYSIS TO GOVERNMENT EXPENDITURE DECISIONS.

Washington Univ., St. Louis, Mo. Murray L. Weidenbaum.

In: Planning-Programming-Budgeting--A Systems Approach to Management, Chicago, Markham Publishing, p 165-180, 1967.

Descriptors: *Program budgeting, Decision-making, Cost-benefit analysis, Economic evaluation, Resource allocation, Discount rate, Economic efficiency, Systems analysis.

Identifiers: *Planning-Programming-Budgeting, Government expenditures, Cost effectiveness analvsis. Externalities.

This paper evaluates the trend toward the application of economic analysis to public sector decision-making. Antecedents of Planning-Programming-Budgeting (PPB) are discussed to provide the groundwork for an evaluation. The use of cost-

benefit analysis by Federal agencies to rank and compare prospective projects demonstrates the use of objective economic analysis to narrow the areas in which political forces may operate. The Planning-Programming-Budgeting-System (PPBS) is a combined planning and budgeting process where national goals are reduced to specific program operations and the most economical method of executing these objectives is identified. Three steps are required in the PPB system; namely, the identification of national goals, the relation of broad goals to specific alternative programs and the translation of the resource inputs into budget dollars. The author finds the long term impact of PPB to be beneficial as there is less reliance on subjective judgment with information on the economic returns of the respective programs. This article is relevant for water administrators concerned with the application of PPB to water resource programs. (Siegenthaler-Rutgers) W71-04468

SYSTEMS ANALYSIS TECHNIQUES FOR PLANNING-PROGRAMMING-BUDGETING, Rand Corp., Santa Monica, Calif.

E. S. Ouade.

In: Planning-Programming-Budgeting: A Systems Approach to Management, Chicago, Markham Publishing, 1967, p 292-312.

Descriptors: *Systems analysis, Decision-making, Linear programming, Operation research, Uncertainty, Economic efficiency, Queueing theory.

Identifiers: *Planning-Programming-Budgeting, Objective function, Cost-effectiveness analysis.

Systems analysis is an analytic study designed to help a decision-maker identify a preferred choice among possible alternatives. The possible applica-tion of the systems analysis to Planning-Pro-gramming-Budgeting (PPB) is considered. The systems analysis method constructs and operates within an abstraction of the actual problem. The analysis process first considers the decision-makers objectives, then alternative strategies, and their respective costs. The model estimates for each alternative the costs that would be incurred and the extent to which the objectives would be attained. A criteria weighs costs against performance and arranges the alternatives in order of preference. The uniqueness of the method is the emphasis on the whole problem, the use of uncertainty and quantification using mathematical models all based on scientific methods. The article is relevant for water administratorsconcerned with decision-making models to apply to project evaluation. (Siegenthaler-Rutgers) W71-04469

PUBLIC EXPENDITURE BUDGETING,

Michigan Univ., Ann Arbor.

Peter O. Steiner

Washington, The Brookings Institution, 1969. 117

Descriptors: *Budgeting, *Decision-making, Costbenefit analysis, Resource allocation, Welfare economics, Discount rate, Economic efficiency, Constraint.

Identifiers: *Public expenditure, *Public interest, Externalities, Transaction costs, Public good, Objective function, Opportunity cost.

The author considers the political-economic process of reaching and implementing public expenditure decisions. The theory of public expenditure is considered as two different propositions; namely, the theory of marginal public expenditure and the theory of the public interest. The public interest discussion is concerned with the manner in which demands for public activity are articulated and legitimized. Although alternative views on the nature of the public interest reveal no consensus, the author stresses that collective social priorities can be inferred from past social actions and can serve as a guide to public decision-making. To articulate the public interest, a multi-dimensional ob-

jective function is preferable to a single dimensional one stressing efficiency in order to avoid bias in the valuation of intangibles. Marginal public expenditure theory is concerned with how the decision-maker chooses among competing demands given constraints. Cost-benefit analysis is relevant here for project selection and public decision-making, but the author advocates better measurements of benefits and costs rather than conceptualization. This book is relevant for water resource planners concerned with the economic evaluation of prospective water projects. (Siegenthaler-Rutgers) W71-04470

PROGRAM BUDGETING AND BENEFIT-COST

Maryland Univ., College Park; and Management Analysis Center, Inc., Washington, D.C.

Harley H. Hinrichs, and Graeme M. Taylor (editors). Pacific Palisades, California: Goodyear Publishing Company, 1969. 420 p.

Descriptors: *Program budgeting, *Cost-benefit analysis, Decision-making, Risk, Resource alloca-tion, Systems analysis, Economic evaluation, Discount rate, Interest rate.

Identifiers: *Capital budgeting, *Public expenditure, Externalities, Objective function, Planning-Programming-Budgeting, Cost-effectiveness

This book is a series of essays designed to present a logical sequence for understanding cost-benefit analysis. It begins by stating the rationale for costbenefit analysis and provides a comprehensive primer of benefit-cost theory. Readings and cases are presented to illustrate the concept of a program budget, the design of program structure, determination of objectives, criteria and output measures. An extensive treatment of program analysis is presented with essays on capital budgeting, decision rules, externalities, multiple objectives, risk uncertainty, and systems analysis. Fifteen case studies are included concerned with government agencies and the use of program budgeting. In the last part of the book, the issue of multipurpose budget systems is discussed as well as the possible uses and misuses of analysis. This book is relevant for water resource planners concerned with a systems approach to program evaluation. (See also W71-04472 thru W71-04475) (Siegenthaler-Rutgers) W71-04471

GOVERNMENT DECISION-MAKING AND THE THEORY OF BENEFIT-COST ANALYSIS: A PRIMER,

Maryland Univ., College Park.

Harley H. Hinrichs.

In: Program Budgeting and Benefit-Cost Analysis, p 9-20, 1969.

Descriptors: *Decision-making, Optimization, Cost-benefit analysis, Resource allocation, Risk, Optimization, Interest rate, Budget constraint, Political constraint, Social welfare, Probability.
Identifiers: *Cost-effectiveness, *Objective func-

tion, *Externalities, Pareto optimality, Feedback, Shadow prices, Internal rate of return, Time preference, Opportunity cost.

This article gives a step by step description of costbenefit analysis along with applications to government decision-making. Important to this method is the statement of the problem or specifying ends or benefits and the measurement of these benefits in dollar terms. Next, costs must be specified and measured in monetary terms. In setting objectives as ends, the author cites possible pitfalls such as the confusion of means as ends and the exclusion of nonquantifiable variables in decision-making. Once the objective function is known, the next step is to recognize the physical, legal, distributional, budget and political constraints connected with resource scarcity. The question of externalities is discussed along with the potential repercussions that can result when the indirect effects of decision-making

are not considered. Once the decision-maker has specified and quantified his benefits and costs, allowing for difference in time through the interest rate, he must allow for uncertainty through various adjustments to simulate a real world situation. This primer provides a brief overview for water resource planners concerned with decision-making and program evaluation. (See also (Siegenthaler-Rutgers) W71-04471) W71-04472

MULTIPURPOSE BUDGET SYSTEMS,

Brookings Institution, Washington, D.C. Allen Schick

In: Program Budgeting and Benefit-Cost Analysis, p 358-372, 1969.

Descriptors: *Multi-purpose budgeting, *Resource allocation, Economic evaluation, Decision-making. *Planning-Programming-Budgeting, Identifiers: Crosswalking imperfect integration.

Planning-Programming-Budgeting (PPB) tegrates the three core functions of budgeting, control, management, and planning into the budget process. Under PPB, government agencies have to reconcile program accounts with the existing appropriations structure resulting in a 'crosswalk problem'. The Crosswalk problems occur because of the disparity between the classification in the program structure and appropriations and is one aspect of the broader problem of a multipurpose budget system. The success of PPB is contingent on the development of a system that transfers control and management to lower levels and elevates planning. The author suggests that although incompatibilities do exist in a multi-purpose budget strategy, it is possible to integrate the functions through changes in the definitions of roles, improved allocation of budgetary functions and better data utilization. Although integration is cited as a solution, it must be imperfect and gradual in order to develop the optimum level with experimentation and practice. This article is relevant for water administrators concerned with budgetary decision processes. (See also W71-04471) (Siegenthaler-Rutgers) W71-04473

SURVEY OF USE BY FEDERAL AGENCIES OF THE DISCOUNTING TECHNIQUE EVALUATING FUTURE PROGRAMS,

Comptroller General of the United States, Washington, D.C. Elmer Staats

In: Program Budgeting and Benefit-Cost Analysis, p 212-228, 1969.

Descriptors: *Economic evaluation, *Cost-benefit analysis, Discounting, Present value, Cost, Water resource development, Resource allocation, In-

Identifiers: *Implicit discount rate, Explicit discount rate, Opportunity cost, Rate of return.

This article discusses a survey made by the General Accounting office concerning the use of discounting by federal agencies in evaluating future programs. The theory underlying the discounting technique is that calculation of the present values through discounting makes possible a comparison of costs and benefits. These comparisons aid in program evaluation and in the choice between alternative programs. The distinction between implicit and explicit discount rates is cited. The results of the survey indicate a majority of the agencies in the study are planning to use discounting in decisionmaking. A divergence of opinion on discounting is reflected in agency practices. Differences to exist in that some agencies do not use discounting with the result that decision-making may result in resource misallocation. In conclusion, the author stresses the need for greater standardization in discounting techniques to enhance the quality of decision-making. This article provides a useful background of current Federal discounting policies and should be of general interest for the evaluation

of public water investment projects. (See also W71-04471) (Siegenthaler-Rutgers) W71-04474

THE SYSTEMS ANALYSIS APPROACH, Department of Defense, Washington, D.C.

Alain C. Enthoven.

In: Program Budgeting and Benefit-Cost Analysis, p 159-168, 1969.

Descriptors: *Systems analysis, Decision-making, Risk, Cost-benefit analysis, Resource allocation, Budgeting, Social welfare, Simulation, Feasibility. *Planning-Programming-Budgeting. Cost-effectiveness, Bias.

The systems analysis approach to problems is to examine an objective in its broadest aspects and develop for the decision-maker information that will aid him to select the efficient method. The selection process requires the identification of alternative ways of achieving the objective and then the estimation of the benefits and the costs of each alternative. The author states the method tries to identify the alternative that yields the greatest effectiveness at the least cost. Limitations of systems analysis include overemphasis on quanitative analysis, a confusion of performance with effectiveness and a bias toward new approaches in favor of old ones. A discussion of the application of systems analysis to the Defense Department is given with the contribution of the method to the decisionmaking process stressed. The author stresses that the method can be applied to social problems as well and is important in the design and development of alternative approaches of program development. This article is relevant for water studies concerned with the application of budgeting methods to water resource planning. (See also W71-04471) (Siegenthaler-Rutgers) W71-04475

PUBLIC EXPENDITURES AND POLICY ANAL-

Grinnell Coll., Iowa; and Pennsylvania Univ., Philadelphia.

Robert H. Haveman, and Julius Margolis (editors). Chicago, Markham Publishing Co., 1970. 596 p.

Descriptors: *Economic evaluation, *Government, *Budgets, *Planning, Risk, Spillover, Income, Cost-benefit analysis, Water pollution, Rate of discount, Prices, Natural resource development, Project planning, Social aspects, Water law. Identifiers: *Public expenditure analysis, *Institutions, Programming, Externalities, Income distribution, Unemployment, Shadow prices, Collective ac-

The papers presented in this volume are intended to survey the theory of public expenditure analysis and evaluate federal government practices in choosing among investment alternatives. This volume should be of particular interest to the economist concerned with improving the efficiency of government decision making in the area of water resource development. In the first section of the book the papers are devoted to exploring the economic basis for public expenditures and other governmental action. Particular attention is paid to the problems of market failure, income distribution and the appropriate economic functions of government. The second section deals with the institu-tional arrangements which affect the ability of the federal government to implement efficient public expenditure policy. The following section analyzes some of the empirical problems encountered in estimating the benefits and costs of public expenditure alternatives. These include the rate of discount, the treatment of risk and uncertainty, and the effect of unemployed resources. The fourth section contains an evaluation of the Planning-Programming-Budgeting System and its component parts. The concluding section deals with un-resolved issues and the next steps for policy analysis and program evaluation in selected functional

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areas of the federal budget. (See also W71-04478 thr W71e04482) (Murphy-Rutgers) W71-04477

THE PUBLIC SECTOR AND THE PUBLIC IN-TEREST,

Michigan Univ., Ann Arbor.

Peter O. Steiner.

In: Public Expenditures and Policy Analysis, 1970, p 21-58.

Descriptors: *Government, *Economic evaluation, Economic efficiency, Spillover, Decision-making, Discount rate, Costs, Environmental quality, Social

aspects, Demand, Welfare economics.
Identifiers: *Public goods, *Market failure, Collective action, *Externalities, Multi-dimensional objective function, Utility, Social welfare, Willingness to pay.

The author attempts to establish a basis of collective concern and for the provision of public goods. This paper provedes and discusses the nature of a public good throug a number of examples. Of par-ticular interest to the water researcher is the dicussion given to those public goods concerned with the quality of the environment. The theories of individual utility, willingness to pay, and aggregate social welfare are presented, along with their economic implications and their role as extramarket forces in the economy. Because noncomparability is a feature of many public choice problems the author stresses a multi-dimensional objective function, which explicitly considers conflicts among objectives, rather than one involving only economic efficiency. The concluding section co-siders how the political structure articulates social priorities and the extent to which the process itself determines the outcome. This paper is relevant to the water researcher interested in defining the proper role of government in water resources development. (See also W71-04477) (Murphy-Rutgers) W71-04479

EVALUATING PUBLIC **EXPENDITURES** UNDER CONDITIONS OF UNEMPLOYMENT,

Grinnell Coll., Iowa. Robert H. Haveman.

In: Public Expenditures and Policy Aanalysis, 1970, p 330-345.

Descriptors: *Income, *Costs, *Economic evaluation, Social aspects, Government, Resource allocation, Demand, Regional analysis, Cost-benefit analysis, Dams, Capital, Investment.
Identifiers: *Unemployment, *Monetary costs, *Real costs, Social costs, Social labor costs.

This paper attempts to improve the methods for evaluating the economic gains and the costs of alternative expenditure projects. It discusses the reasons why monetary costs fail to reflect real so-cial costs when the economy is experiencing unemployment and excess capacity, and presents a method for adjusting monetary costs when such conditions prevail. The implementation of this method eliminates the overstatement of real costs by monetary costs when some of the resources drawn into use by a public expenditure have idleness as their alternative. This paper is of significance to cost-benefit analyses of water resource investments. (See also W71-04477) (Murphy-Rutgers) W71-04480

SOCIAL RETURNS FROM PUBLIC TRANS-PORT INVESTMENT: A CASE STUDY OF THE OHIO CANAL,

California Univ., Riverside.

Roger L. Ransom. Journal of Political Economy, Vol 78, No 5, p 1041-1060, September-October 1970.

Descriptors: *Economic evaluation, Decision-making, Economic rent, Average cost, Linear programming, Economic efficiency.

Identifiers: *Transportation costs, *External benefits, Bias, Parameter, Constant costs.

Traditionally, the historical approach to canal development has been the study of the decisionmaking process which led states to undertake a canal project. This paper focuses on the Ohio Canal and estimates the external benefits accruing to the Ohio region as a measure of the contribution of the canal to Ohio's development. To indicate the external returns to the canal, the theory of economic rent is used. The author estimates the return from the Ohio Canal for six three year periods using as data the traffic in exports and imports to the region. The shipment data were adjusted so the pattern of least-cost shipments could be determined by linear programming. The estimates of return were based on current charges by commodity class. The results indicate from 1837-1850, returns from the canal were profitable; however, after 1850 with railroad competition, profits declined. The profitable returns demonstrate the impact of the canal on the development of the market in this region a factor which the railroads utilized. In conclusion the capital investment in the canal was repaid and for that period, the investment was efficient. This article offers a possible methodology to evaluate the impact of a water project on economic growth and development. (Siegenthaler-Rutgers) W71-04483

HYDROGEOLOGICAL AND ENGINEERING GEOLOGICAL FACTORS IN REGIONAL SPA-TIAL PLANNING,

Institute for Geological and Geophysical Research, Belgrade (Yugoslavia). For primary bibliographic entry see Field 04C. W71-04613

WATER RESOURCES DEVELOPMENT NEEDS IN THE SOUTHERN WATER RESOURCES CONFERENCE REGION,

Reuben J. Johnson.

Southern Water Resources Conference, 15th Meeting, Tulsa, July 16-18, 1969. Council of State Governments, Southern Office, Atlanta, nd p 39-

Descriptors: *Water resources development, *Water policy, *Water management (Applied), *Southeast U.S., Project purposes, Water utiliza-tion, Conservation, Water conservation, Recreation facilities, Interstate commissions, State governments, Local governments, Non-structural alternatives, Water supply, Water pollution control, Public utilities, Planning, Reservoirs, Government, January, Water allocation (Policy), Environ. ment finance, Water allocation (Policy), Environ-ment, Aesthetics, Sewage treatment, Personnel, Legislation.

Presented at the fifteenth meeting of the Southern Water Resources Conference, this speech presents an analysis of the sixteen areas most in need of serious investigation and prompt implementation. The speaker lists and discusses the need for: (1) flood plain management legislation; (2) regional resource framework studies-most needed in the South; (3) early selection and acquisition of reservoir sites to avoid rising prices; (4) preservation of wild river and greenbelt areas; (5) studies of thermal-electric plant sites to minimize pollution dangers; (6) review and revision of state water laws; (7) consideration of institutional arrangements, such as river basin commissions, to provide for regional planning and resource management; (8) water quality control criteria; (9) coordination of land management with water resource and recreational programs; (10) establishment of water use priorities; (11) consideration of regional water supply and sewage treatment facilities; (12) environmental quality studies; (13) erosion and sedimentation effects of construction methods; (14) aesthetic consideration in project planning; (15) development of financing sources; and (16) the training of personnel in all water resource fields. The speaker urges strong cooperation among all local, state, and federal agencies to implement the needed water resource development programs. (Liptak-Florida) W71-04644

SOCIO-ECONOMIC STUDY OF MULTIPLE-USE WATER SUPPLY RESERVOIRS, Stone (Ralph) and Co., Inc., Los Angeles Calif.

Ralph Stone, and Helen Friedland. Available from NTIS as PB-197 672, \$6.00 in paper copy, \$0.95 in microfiche. Final Report, January 2, 1971. 324 p, 118 tab, 51 fig, 74 ref. OWRR Project C-1633 (3149) (1).

*Multiple-purpose Descriptors: *Recreation, *Cost-benefit analysis, *Mathematical models, *Water resources planning, Computer models, Decision-making, Domestic water, Drainage systems, Economic impact, Lakes, Pro-Drainage systems, Economic impact, Lakes, Property values, Regression analysis, Runoff, Social values, Water pollution sources, Water quality, Watersheds, Water sports, Water supply, Water treatment, Evaluation, Costs analysis, Water resources development, Census. Identifiers: England/Wales system.

The purpose of the study was to determine the social, economic, and health and safety impact of selected recreational activities on, in, or near the terminal reservoir. A preliminary, or basic, cost-benefit mathematical model was designed to in-clude consideration of these factors, and a recommended program for its extension and refinement was developed. Analysis was made of the economic influence on surrounding land values of four proto-type reservoirs: closed, domestic supply only; recreational use only; multipurpose, no body-contact sports; multipurpose, including body-contact sports. For the three reservoirs permitting recreational use, the overall economic influence of recreational usage was estimated, and the available data on reservoir water quality were analyzed. A nationwide survey (48 States responding) was per-formed to determine policies and experience relating to recreational use of the domestic water supply reservoir. Recommendations were developed for coordinated, single-agency, river basin-oriented water resource management suitable for nationwide application based on the England/Wales system. W71-04672

URBANIZATION WITHOUT MODERNIZA-

Kentucky Univ., Lexington. Stephen R. Cain.

Available from NTIS as PB-197 675, \$3.00 in paper copy, \$0.95 in microfiche. Water Resource Research Institute, Mimeographed, 1969. 15 p, 7 ref. OWRR Project No A-022-KY (3).

Descriptors: *Urbanization, Community development, Population, Urban sociology, Social change. Identifiers: *Regional development, Social system.

In certain regions of rural Kentucky the economy has traditionally been based on extractive, exhaustive, and consequently terminal industries. As was the case in Timber Town and in Oil Town, service centers which have developed, diversified and flourished in response to such economic supports have been unable to build the foundation necessary to continue after the cessation of the industrial stimulus. The declined population of Oil Town began when the oil company stopped housing employees; however, the decline increased drastically when jobs became scarce. The attraction of government is demonstrated by the rapidity with which Government Town overwhelmed the other settlements when it became the county seat. The introduction of state and federal aid programs in the 1930's strengthened this attraction as the county government became the local administrator and as state and federal representatives of government programs established offices in the county seat. In rural Kentucky, government has been the most suc-cessful support of multi service center, and the county seat has consequently assumed institutional primacy. (Wray-Chicago)

W71-04676

PLANNED UTILIZATION OF GROUNDWATER BASINS: COASTAL PLAIN OF LOS ANGELES COUNTY.

California State Dept. of Water Resources, Sacra-

For primary bibliographic entry see Field 04B. W71-04683

THE NUCLEAR POWER SCHEDULE STRUG-

GLE, F. C. Olds.

Power Engineering, Vol 79, No 9, p 39-41, September 1970.

Descriptors: *Nuclear power plants, *Electric power plants, Electric power production, *Nuclear energy, Nuclear wastes, Thermal pollution, Prediction, Future planning, Economic prediction.

The future development of nuclear power electric energy production is projected for the next 7 years. It is expected that by 1975, 83 nuclear power plants will be put into operation with a total capacity of 62,600 Mwe. The problems connected with this nuclear power production growth are discussed. Slippage seems to have increased during the past period in nuclear power plant schedules. The impact of recent emphasis on environmental problems on increasing power capabilities is noted to have contributed to what appears a power shortage for the next several years. (Vanderbilt) W71-04722

ECONOMICS OF AIR AND WATER POLLU-

Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.

Available from NTIS as PB-195 424, \$3.00 in paper copy, \$0.95 in microfiche. Bulletin No 28, Water Resources Research Center, Edited by W. R. Walker, Oct 1969. 250 p.

Descriptors: *Cost-benefit analysis, *Economic justification, *Multiple purpose projects, *Third party effects, *Water pollution control, Benefits, Labor supply.
Identifiers: *Effluent charges.

The work represents proceedings of a seminar conducted at Virginia Polytechnic Institute, on 'Economics of Air and Water Pollution', for the purpose of explaining some of the relevant economic principles to engineers and administrators. There were seventeen speakers, talks relevant to water pollution covered interdisciplinary approaches, externalities, public and private goods, proposals for subsidies or effluent charges for waste abatement, laws and regulations for control, cost benefit analysis, and public expenditures under conditions of unemployment. Generally similar coverage was given to air pollution problems. (See also W71-04740 thru W71-04743) (Whipple-Rutgers) W71-04739

MARKET FAILURES - WHY EXTERNALITIES ARE NOT ACCOUNTED FOR IN THE MAR-KET.

Office of the Chief of Engineers (Army), Washington, D. C. Civil Works Directorate.

In: Economics of Air and Water Pollution, Water Resources Research Center, Virginia Polytechnic Institute, Blacksburg, Va., p 29-36, Oct. 1969.

Descriptors: *Third part effects, *Resource allocation, *Decision making, Institutions, Resource allocation, Public benefits, Economic efficiency.

Identifiers: *Externalities, Market mechanisms, Public goods.

Defines public goods. Explains that environmental advantages have limits in capacity and therefore are not classic examples. Action to distribute external advantages require group decisions, public subsidy, tax measures, legal prohibitions, changes in property rights, public enterprise, or social pressure. If consumers want more natural environmental products they must be prepared to bid more, in terms of devoting more resources to this purpose. There is a point at which society must make a decision as to the cost of further improvement compared to the value of alternative investments. (See also W71-04739) (Whipple-Rutgers) W71-04741

THE NATIONAL WATER COMMISSION, AN-NUAL REPORT FOR 1970.

National Water Commission, Washington, D. C.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402 Price \$0.30. Interim Report No 2, December 31, 1970. 41 p, 2 append.

Descriptors: *Planning, *Economics, *Environmental effects, *Social aspects, *Ecosystems, *Economic feasibility, Regional analysis, Resource allocation water pollution control decision making. Identifiers: *Ecosystem response.

This is the second interim report of the National Water Commission. The first interim report outlined the organization for the task to be accomplished. At this time, only a few reports have beencompleted; therefore only a general idea of progress is available. Through the commissions staff, consultants, panels, and a number of contracts with universities and consulting firms, twenty-two special studies are underway. Studies are broadly classified as covering legal matters, engineering and environmental sciences, social and behavioral sciences, and forecasts. Studies of economic interest include the ecosystem's response to water manipulation, especially recycling, the value of water in its several uses, metropolitan problems including waste water management, market and administrative allocation as possible supplements to water law systems, the use of water resources to promote regional economic development, effects of water development on environment, critique of current methods of economic evaluation and a critical review of the U.S. program of water pollution control. (Whipple-Rutgers) W71-04744

ECONOMIC INSTITUTIONS AS SOCIAL IN-DICATORS.

Kentucky Univ., Louisville.

Charles R. Smith.

Paper read in the Symposium 'Emerging County Subcultural Units in Kentucky,' American Society for Ethnohistory, Ithaca, NY, Oct 24, 1969. 14 p, 4 tab, 20 ref. OWRR Project A-022-KY (7).

Descriptors: *Planning, *Social change, Social aspect, Analytic techniques, Evaluation, *Institu-

Identifiers: *Comprehensive planning, Social system, Interdisciplinary studies, Social system, Regional development.

Traditionally social scientists have worked in the analyzation of human behavior, and not prediction of behavior. However, in an age where technological innovations are rapidly diffused into diverse cultures and sub-cultures, the necessity of planning for implementation is increasing in order to minimize the conflict between innovation and the culture involved. Social indicators could provide planners with information additional to the sophisticated system of economic indicators which allows planners to measure in one way the overall state of the economy. This approach is intended to focus attention on human problems associated with technological innovations and to provide planners with information that might enable them to implement change with a minimum of conflict. A study was made of a rural county in Kentucky to establish position on the modernization continuum for

summer of 1969. The social indicators reveal that the county is moving toward the Gesellschaft pole on the modernization continuum because of an increase in immigrant and externally owned businesses, improved transportation, and difficulty for providing employment for youth. Social indicators can be used to assess the direction of a community to permit better planning. (Wray-Chicago) W71-04746

METROPOLITAN PLANNING AREA, RE-GIONAL ANALYSIS.

Muskegon County Metropolitan Planning Commission, Mich.

Aug 1970. 15 p, 2 pl, 2 map.

Descriptors: *City planning, Community development, Planning, *Area Redevelopment, Michigan. Identifiers: *Metropolitan areas, Urban environment, *Muskegon, Mich.

There are two general approaches to defining a conceptual framework for regions, the geographic and the sociological. The geographic approach serves mainly to describe existing conditions and provides only limited information on the origins of regional relationships. The concept is not very productive for planning and development applica-tions. The sociological approach provides the necessary corrective to the geographic in its emphasis on a flexible definition. In order to be successful in meeting development objectives, regions must represent the reality of a dynamic social order. Muskegan, Michigan is described, including its economy, housing, community services, institutions, transportation, recreation, and communications. Regions for development should be identified based on the particular development purpose intended. Institutional frameworks should be sought which differentiate between policy generation, program review, and effectuation. Recommendations include flexible development regions, multiple efforts to identify development potential, and formation of the West Michigan Shoreline Regional Planning Commission. (Wray-Chicago) W71-04747

REGIONAL ACTION: KEY TO THE FUTURE OF SAN FRANCISCO BAY/I, California State Water Resources Control Board,

Sacramento. Priscilla Perlman.

Water and Wastes Engineering, Vol 7, No 5, p 45-47, May 1970. 2 fig.

Descriptors: Water quality control, *Programs, *Planning, *Water management, *Pollution abatement, California. Identifiers: San Francisco.

The completion of the first phase of a program for the protection of water resources in California by State Water Resources Control Board is presented. Objectives and principles have been set forth for a comprehensive study to develop a water quality management program for San Francisco Bay and the Sacramento-San Joaquin Delta of California. The program has taken over four years to research and has involved engineering firms, oceanographers, demographers. occanographers, demographers, economists, private consultants and government agencies at a cost of almost three million dollars. (See also W71-04810). (Ensign-PAI) W71-04809

REGIONAL ACTION: KEY TO THE FUTURE OF SAN FRANCISCO BAY/2,

California State Water Resources Control Board,

Priscilla Perlman.

Water and Wastes Engineering, New York, Vol 7, No 6, p 70-73, June 1970. 2 fig, 4 ref.

Descriptors: Water quality control, Programs, *Planning, *Water management, *Pollution abatement, California.

Field 06—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

Identifiers: San Francisco.

In part 1 of this article, the objectives and princi-ples of this study were set forth. This part deals with the proposals for developing a water quality management program. It was found that present conventional waste water treatment methods fail to a significant degree to remove both toxicants and biostimulants. An immediate solution to present water quality problems must be found and a firm basis for maximizing future use of the water resources must be provided. With these things in mind recommendations were made to the legisla-ture and are itemized and stated in the article. Work is under way on several of the critical studies. (See also W71-04809). (Ensign-PAI) W71-04810

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

THE SIMPLE ECONOMICS OF INCENTIVE CONTRACTING

California Univ., Los Angeles.

J. J. McCall.

The American Economic Review, Vol LX, No 5, p 837-846, December 1970.

Descriptors: *Cost allocation, Risk, Economic efficiency, Probability.

Identifiers: *Incentive contracting, Fixed price

contract, Target cost, Target profit.

This paper presents an economic analysis of three different kinds of government procurement contracts; namely, the fixed price contract, the fixed price incentive contract, and the cost plus fixed fee contract. From an analytical point of view, the fixed price and the cost plus fixed fee are special cases of the fixed price incentive contract. In the fixed price incentive contract, the firm establishes a target cost estimate. If actual costs are less than estimated costs, there is government sharing in the profits. Some of the previous analyses of cost estimation in government contracts has been primarily statistical. This study suggests that contractors may bias their cost estimates to conform with their profit maximizing objectives. Because of the peculiar sharing rule that characterizes these contracts, it is difficult for the government agency to distinguish between high and low-cost firms in the bases of target costs. The problem of discriminating between efficient and inefficient firms becomes less serious as the sharing proportion rises and approaches one, the fixed price contract where target costs are unambiguous indicators of the firm's expected costs. This article is relevant to water resource administrators concerned with contract standards and cost allocation. (Siegenthaler-Rutgers) W71-04455

THE COSTS OF DECISION-MAKING. Guetph Univ. (Ontario).

Alex C. Michalos.

Public Choice, Vol IX, No 3, p 39-51, Fall 1970.

Descriptors: *Decision-making, Economic evalua-tion, Economic efficiency, Risk, Operations research, Inventory.

Identifiers: **Cost accounting, Production costs, Implementation costs, Failure costs

This paper constructs a system of cost accounting to be used in the evaluation of the costs of employing decision-makers and decision procedures. Distinctions were drawn among production, implementation, and failure costs. Production and implementation costs are subdivided into methods, materials, personal or overhead costs, while failure costs are subdivided into direct, indirect and estimated value losses. A comparison of the results was made with previous research. The advantage of using an inventory approach to decision-making in the future is that operations research theory becomes applicable to problems of group decision-making. This article is relevant for water administrators concerned with decision-making and project evaluation. (Siegenthaler-Rutgers) W71-04457

AN ECONOMIC INTERPRETATION OF VOTING BEHAVIOR ON PUBLIC FINANCE ISSUES,

Basel Univ. (Switzerland). Rene L. Frey, and Leopold Kohn. Kyklos, Vol XXIII, Fasc 4, p 792-805, 1970.

Descriptors: *Decision making, *Costs, *Taxes, *Income, Economic evaluation, Government, Welfare economics, Financing, Optimization, Prices, Benefits, Social aspects, Government supports,

Forecasting Utility level, *Public goods, *Private opportunity costs, *Voting, *Public opportunity costs, Basel-Sadat.

In this paper the authors seek to analyze the voting behavior of individuals in public finance referenda. They assume that, in popular referenda, voters reveal their true preferences and the authors are thus able to analyze the individual's utility calculus. For this purpose they make use of three different cost concepts: (1) public opportunity costs, (2) private opportunity costs, and (3) expected tax increases. The authors make five hypothesis pertaining to the effect of these cost categories on the utili-ty level of different income classes of voters and examine the determinants of the utility of public projects. The results are tested empirically, in the last part of the paper, for Basel-Sadat (Switzerland). The public good nature of water resource investments make optimal decision making difficult. Since the authors provide a measure of demand for public goods this article should be relevant to the decision process of water resource investments. (Murphy-Rutgers) W71-04459

THE MARGINAL EFFICIENCY OF CAPITAL, THE INTERNAL RATE OF RETURN, AND NET PRESENT VALUE: AN ANALYSIS OF INVEST-MENT CRITERIA,

Michigan State Univ., East Lansing.

James B. Ramsey. Journal of Political Economy Vol 78, No 5, p 1017-1027, September-October 1970.

Descriptors: *Rate of return, *Economic efficiency, *Capital, *Rate of interest, Time, Costs, Investment, Economic evaluation, Price, Profit, Op-timization, Equilibrium, Decision-making. Identifiers: *Net present value, *Multiple roots, *Internal rate of return.

This paper attempts to show that the marginal efficiency of capital is not appropriate for ranking investment alternatives. This measure is an equilibrium concept and should be distinguished from the internal rate of return. The latter, when appropriately defined and used for ranking projects of equal time spans, is identifical to the ranking from net present value. It is also shown that the internal rate of return can always be calculated and has a unique value relative to the market interest rate. In the concluding section, an economic interpretation is given of the multiple roots solution of the marginal efficiency of capital and to the case where there are no real roots. The paper is relevant to the evaluation of alternative investment schemes among water projects. (Murphy-Rutgers) W71-04460

INVESTMENT AND RATE OF RETURN FOR THE REGULATED FIRM,

American Telephone and Telegraph Co., New York.

Blaine E. Davis.

Bell Journal of Economics and Management Science Vol I, No 2, p 245-270, Autumn 1970.

Descriptors: *Utilities, *Government, *Optimization, Capital, Budget, Economic evaluation, Mathematical study, Investment, Management, Financing, Model studies. Identifiers: *Rate of return, *Control theory, *Capital market, *Capital attraction capability, Market valuation.

This paper attempts to present a quantitative framework showing what effect a rate of return specification can have on the structure and composition of the regulated firm's long-range invest-ment decisions and the value the capital market assigns to the firm. It should be of particular interest signs to the firm, it should be of particular interest to those concerned with the operation of publicly regulated water utilities. A formulation is developed for a regulated utility in terms of its capital budgeting. This makes it possible for the author to link the utility's investment decisions to (1) the method the capital market values the utility, and (2) the restriction that rate-of-return regulation imposes on earnings. The paper demonstrates that small changes in the rate of return can have a dramatic impact on market valuation and the firm's investment policy. (Murphy-Rutgers) W71-04462

RESOURCE ALLOCATION WITH INCREAS-ING RETURNS TO SCALE,

Washington Univ., St. Louis, Mo.

Trout Rader.

American Economic Review, Vol LX, No 3, p 814-825, December 1970.

Descriptors: *Resource allocation, *Economics of scale, *Economic efficiency, Optimization, Welfare economics, Marginal costs, Prices, Budgets, Mathematical analysis.

Identifiers: *Consumer efficiency, *Producer efficiency, Full employment, Competition, Distributive justice.

This paper analyzes the necessary and sufficient conditions for efficient allocation of resources and the distribution of products. None of the usual welfare conditions can be extended to the case of increasing returns to scale in one or more industries. Since economics of scale are important in public utilities, the author considers this a major deficiency of welfare economics. Since water utilities are likely to have production functions exhibiting increasing returns, this paper is relevant to the water researcher. A producer efficiency is said to exist if and only if: (1) industries try to maximize production subject to their technology and with trading of factors allowed; (2) factors are fully employed and industries minimize factor costs; (3) all factors are employed and marginal rates of substitution are equalized. There is consumer efficiency only if price equals marginal costs. If the output set is convex, there is consumer efficiency if and only if distribution is competitive and GNP is maximized. (Murphy-Rutgers) W71-04463

THE USE OF SHADOW PRICES,

California Univ., Los Angeles. Roland N. McKean.

In: Problems in Public Expenditure Analysis, Washington, D.C., The Brookings Institution, 1968, p 33-77.

Descriptors: *Cost benefit analysis, *Prices, *Measurement, *Economic evaluation, Government, Optimization, Welfare economics, Spillover, Deci-

sion-making, Cost minimization.
Identifiers: *Shadow prices, *Pareto optimality, *Externalities, Market value, Nonmarket value.

This paper deals with the problem of measuring the social costs and social benefits of a government project. The author discusses the maximization of society's welfare from Pareto optimal criteria. He reasons that this can be pursued by attaching prices, that accurately reflect the values of the benefits to those who receive them and of the costs to those responsible for their creation. Where accurate private market comparisons cannot be made shadow prices may be needed for accurate evaluations. However, their derivation is extremely difficult due, in part, to the presence of externalities. In conclusion, the author states that benefit cost analysis is an effective tool but, by itself, incapable of optimal decision-making. There is a significant potential use for shadow prices of water oriented recreation activities in benefit cost justification of water investments. This possible use plus the role of shadow prices in other difficult to measure benefits makes this article relevant to water studies. (Murphy-Rutgers) W71-04476

ON THE DISCOUNT RATE FOR PUBLIC PRO-IECTS.

Princeton Univ., N.J. William J. Baumol.

In: Public Expenditures and Policy Aanlysis, 1970. p 273-290.

Descriptors: *Rate of discount, *Interest rate, *Economic evaluation, *Costs, *Government, Economic efficiency, Social aspects, Taxes, Risk, Optimization, Investment.
Identifiers: *Opportunity costs, *Rate of return,

Second best, Externalities.

The discount rate is of critical importance for the evaluation of a government project due to its effects on the allocation of resources between the private and public sectors of the economy. The author demonstrates that the correct discount rate for a government project is the rate of return the resources could earn in the private sector. In addition to this, taxes in the private sector should be taken into account and will call for a discount rate equal to the before tax rate of return in the private sector. The correct social discount rate is then a weighted average of the opportunity cost rate for the various sectors from which the project would draw its resources. The author reasons that there should be no deductions for a risk component in the rates of return observed in practice but that the effect of externalities in both the government and private sector be allowed for. Concluding, the paper argues that it is possible to derive figures considerably more defensible than conventional calculations. This article is relevant to the analysis of government investments in water resources. (See also W71-04477) (Murphy-Rutgers) W71-04481

SHADOW PRICES FOR INCORRECT OR NON-EXISTENT MARKET VALUES, Pennsylvania Univ., Philadephia.

Julius Margolis.
Edited by Haveman, Robert H. In: Public Expenditures and Policy Aanalysis, 1970, p 314-329.

Descriptors: *Prices, *Economic efficiency, *Government, Decision-making, Costs, Cost-benefit analysis, Rate of interest, Land, Demand, Budgets, Income, Markets, Economic evaluation. Identifiers: *Shadow prices, *Public goods, PPBS, Input costs, Productivity.

This paper focuses on the analysis of how governments assign price-like values, or shadow prices, to their inputs and outputs. Because of market imperfections, relative prices do not reflect relative costs and are therefore not always a measure of relative and are therefore not always a measure of relative social values. Shadow prices are computed to reflect these social values. They are usually a corrected market price for both inputs and outputs and are meant to explicitly consider the opportunity costs involved. In the case of many social goods, distribution is often at zero price, thus giving no direct measure of the correct price. The intermediate good approach, the cost savings approach and the direct estimation approach are procedures described by the author to estimate prices. The correct information needed to calculate shadow prices rect information needed to calculate shadow prices requires incentives for those who make and implement the decisions. The absence of a market for many of the benefits generated from water resource development necessitates the computation of shadow prices or implicit values. Accordingly, this paper is relevant to the water researcher engaged in the estimation of social and private benefits derived from water investments. (See also W71-04477) (Murphy-Rutgers)

W71-04482

POLLUTION CHARGES INCOME AND THE COSTS OF WATER QUALITY MANAGEMENT, Ohio State Univ., Columbus. Dept. of Economics. For primary bibliographic entry see Field 05G. W71-04736

SOME DETERMINANTS OF DETROIT'S RE-GIONAL SHARE OF ECONOMIC ACTIVITY IN SELECTED INDUSTRIES.

Wayne State Univ., Detroit, Mich. Dept. of Economics.

For primary bibliographic entry see Field 06A. W71-04762

REGIONAL TRADE AND STRUCTURE MODEL FOR POLLUTION ABATEMENT STUDY,

Ohio State Univ., Columbus. Dept. of Economics. For primary bibliographic entry see Field 06A. W71-04763

TRADE STUDY RELEVANT TO POLLUTION ABATEMENT IN THE WESTERN BASIN OF LAKE ERIE,

Ohio State Univ., Columbus. Dept. of Economics. For primary bibliographic entry see Field 06A. W71-04764

OPTIMIZATION OF AN ELECTRODIALYSIS PLANT,

McDonnell Douglas Astronautics Co., Newport Beach, Calif. Water Technology Dept. For primary bibliographic entry see Field 08C. W71-04767

6D. Water Demand

EVALUATION OF THE DECISION PROCESS IN WATER RESOURCES PLANNING, Stanford Univ., Calif. Dept. of Civil Engineering. For primary bibliographic entry see Field 06A.

6E. Water Law and Institutions

PUBLIC BEACH, CITY OF NEW YORK, V WEST TENTH ST REALTY CORP (DISPUTE OVER SUBMERGED OCEAN LAND).

256 NY 222, 176 NE 173-174 (1931).

Descriptors: *New York, *Land tenure, *Riparian land, *Avulsion, Condemnation, Eminent domain, Compensation, Condemnation value, Real property, Legal aspects, Judicial decisions, High water mark, Boundaries (Property), Boundary disputes, Land, Ownership of beds.

Plaintiff public beach sought to condemn defendant's ocean front property. A portion of the land lay below the high water mark, having been formerly submerged by avulsion. Plaintiff contended that defendant did not own this portion, since his deed read 'to the Atlantic Ocean.' Defendant contended that his land included this strip, since a predecessor's conveyance was to the high water mark at the date. Noting that in the absence of a contrary intent, the grantor is presumed to have conveyed all he owned, not reserving the fee of submerged lands, the Court of Appeals of New York held that defendant's title extended past the present high water mark to include the avulsion. Hart-Florida) W71-04437

PEOPLE EX REL CARLSTROM V HATCH (OWNERSHIP OF MARSH MEANDERED AS A LAKE).

For primary bibliographic entry see Field 02H. W71-04438

LUND V COX (ACTION TO QUIET TITLE AGAINST BATHING EASEMENT) 281 Mass 484, 183 NE 714-717 (1933).

Descriptors: *Massachusetts, *Easements, *Land tenure, *Boundary disputes, Boundaries (Property), Beaches, Swimming, Right-of-way, Judicial decisions, Legal aspects, High water mark, Low water mark, Recreation.

Plaintiff sought to quiet title free of incumbrances to beachfront property to which he held legal title. Defendant contended that she held bath-house and bathing privileges under a prior grant. Defendant contended that the grant of an easement in the 'beach' gave her rights in the property between high and low water marks. The Supreme Judicial Court of Massachusetts, in affirming a judgment for plaintiff, stated that in a deed passing title 'northerly by the sea,' the boundary would run along the low water mark. The court further stated beach,' as used in the deed granting bathing privileges, meant the land above the high water mark, rather than the area between high and low water marks. (Hart-Florida) W71-04443

NIAGARA FALLS POWER CO V WATER POWER AND CONTROL COMM'N JUDICIAL REVIEW OF POWER COMMISSION'S RENTAL AWARD FOR WATERS OF NAVIGABLE RIVER).

267 NY 265, 196 NE 51-57 (1935).

Descriptors: *New York, *Administrative decisions, *Rent, *Hydroelectric plants, Hydroelectric project licensing, State governments, Legislation, Federal government, United States, Navigable rivers, Navigation, Dams, Diversion dams, Diversion, Treaties, Hydroelectric power, Administrative agencies, Judicial decisions, Legal aspects, Administrative agencies, Parmite judication procedure, Permits.

Plaintiff power company sought review of defendant state commission's order fixing an annual rate of \$5 per horsepower for water diverted from a navigable river. The statute permitting plaintiff to divert water reserved to the state the right to charge an equitable rental. Plaintiff contended that the rental was excessive. The Court of Appeals of New York noted that: (1) whether the river was navigable at the diversion point was immaterial for commerce purposes, since a river navigable in part is navigable in whole; (2) plaintiff was subject to congressional regulation of navigation; (3) Congress and the state have joint control of the public interest in the river; and (4) the statute permitted the state to charge rental for use of the water, not merely an administrative charge. The court observed that plaintiff was bound by the statute giving the state the right to charge an equitable rental. Since defendant had taken evidence bearing upon the reasonable rental value of the water diverted by plaintiff, there was no evidence that defendant's order was arbitrary. (Hart-Florida) W71-04445

CLEVELAND, CC AND ST L RY V MUMFORD (ASSESSMENT OF RAILROAD FOR EXPENSES OF BUILDING LEVEE). 197 NE 826-837 (Ind 1935).

Descriptors: *Indiana, *Levees, *Railroads, *Assessments, Compensation, Eminent domain, Condemnation, Payment, Bridges, Floods, Navigable rivers, Rivers, Federal government, United States, Flood protection, Dikes, Shore protection, Judicial decisions, Legal aspects, Drains, Governments, State governments, Navigation, Flood control, Taxes.

Plaintiff railroad company brought action to prevent construction of a levee. Several rivers frequently overflowed, and defendant riparian landowner petitioned for construction of the levee, which would force plaintiff to rebuild its track in the affected area. Furthermore, plaintiff was to be assessed for benefits derived from the levee. Plain-

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tiff contended that damages should be allowed for its rebuilding expenses. The Supreme Court of Indiana stated that: (1) congressional approval was not required to construct the levees, since federal control extended only to the channel of navigable streams; (2) plaintiff's property was subject to the state police power to construct levees for public benefit; (3) plaintiff must conform its bridges and tracks to the levees without compensation; (4) requiring plaintiff to rebuild was not a fifth amendment taking of property; (5) plaintiff could be assessed for any special benefit exceeding community benefit; (6) whether plaintiff's property was specially benefited was a fact question; and (7) if plaintiff received no special benefits, assessment would be a fifth amendment taking. Although determing that plaintiff could not recover rebuild-ing expenses, the court held that plaintiff could not be assessed except for special benefits exceeding rebuilding expenses. (Hart-Florida) W71-04464

CRAGE V CITY OF BUFFALO (DISCHARGE OF SEWAGE INTO CANAL AS NUISANCE). 6 NE2d 607 (1937).

Descriptors: *New York, *Sewage, *Water pollution, *Canals, Sewage disposal, Domestic wastes, Water pollution sources, Legal aspects, Judicial decisions, Waste disposal, Disposal.

Plaintiff's land was contiguous to defendant's canal. The sewers from plaintiff's land as well as from that of others discharged into the canal. After diverting his own sewage from the canal, plaintiff sued, contending that the sewage discharge was a nuisance. The Court of Appeals of New York held that: (1) plaintiff took possession of the premises knowing of the sewage discharge, (2) that neither plaintiff nor his predecessors had any right to discharge sewage into the canal, and (3) that plaintiff had created a great part of the nuisance. Accordingly the decree of the lower court dismissing the complaint was affirmed. (Hart-Florida) W71-04490

BLATCHFORD V VOSS (DISPUTES OVER SUPREMACY OF MEANDER OR PLAT LINE). 219 NW 100-102 (Wis 1928).

Descriptors: *Wisconsin, *Land tenure, *Boundary disputes, *Meanders, United States, Riparian land, Lakes, Boundaries (Property), Shores, Real property, Legal aspects, Judicial decisions, Land.

Plaintiff riparian landowner brought ejectment against defendant riparian landowner. Defendant owned two lots, one north of plaintiff's and another west of plaintiff's. A small lake inlet extended through defendant's west lot and into plaintiff's lot. Plaintiff claimed land north of the inlet within the northern plat line of defendant's west lot. Plaintiff asserted that since the government survey showed a meander line as his west boundary, he was entitled to all the land extending to the actual water line. The Supreme Court of Wisconsin stated that in conveyance from the United States, the water line, rather than the meander line, is the true boundary. However, if there is no water nearby, this rule is inapplicable. Determining that when there is a conflict, meander lines are subordinate to section lines, the court held that plaintiff's lot could not extend past the section line since the water was distant from the meander line and defendant's plat line was paramount. (Hart-Florida)

EAST BAY SPORTING CLUB V MILLER (RIGHT OF PUBLIC TO USE PRIVATE WILDLIFE-MANAGEMENT LANDS ON LAKE ERIE).

118 Ohio St 360, 161 NE 12-16 (1928).

Descriptors: *Ohio, *Lake Erie, *Fishing, *Navigable waters, Fish management, Recreation, Fish conservation, Lakes, Bays, Watercourses (Legal),

Intermittent streams, Judicial decisions, Marshes, Wildlife conservation, Wildlife, Wildlife habitats, Wildlife management, Legal aspects.

Plaintiff sporting club brought action to enjoin defendant citizen from hunting and fishing upon its lands. The disputed lands were primarily marshes. Defendant asserted the right to hunt and fish the lands as a member of the public and asserted that deprivation of such right was unconstitutional. The Supreme Court of Ohio noted that: (1) the public is entitled to fish in Lake Erie and its open bay regardless of whether such waters are navigable, (2) waters capable of use as highways for commerce are navigable, and (3) a 'watercourse' is a stream in a natural channel discharging into a larger body of water. Since part of the disputed land was part of a bay of Lake Erie, the court held that defendant was entitled to fish that portion. However, since plaintiff established ownership of the remaining land, which was not part of Lake Erie, the court enjoined defendant from trespassing upon the remainder. (Hart-Florida) W71-04529

CITY OF NORWOOD V SHEEN (DAMAGES FOR SEWAGE DISCHARGE ONTO PRIVATE PROPERTY).

183 NE 177 (Ct App Ohio 1932).

Descriptors: *Ohio, *Sewage disposal, *Sewers, *Eminent domain, Damages, Cities, Land, Land tenure, Judicial decisions, Legal aspects, Adjudication procedure, Water pollution, Sewage, Overflow, Compensation, Eminent domain, Discharge (Water), Waste disposal.

Plaintiff executor of decedent's estate brought suit for damages against defendant city for appropriation of property. Defendant had taken over a sewer and allowed sewage to flow upon decedent's property during decedent's lifetime. Plaintiff contended that this amounted to appropriation of decedent's property. Defendant claimed that, if any cause of action existed, it existed by reason of the creation of a nuisance and the right of action abated on the death of decedent. The trial court returned a verdict for plaintiff and the Court of Appeals of Ohio affirmed. The act of the city permitting sewage to flow over decedent's land constituted an appropriation for such use. The disposal of sewage is a governmental function which may amount to appropriation requiring compensation to the damaged party. Defendant's contention that the act was only actionable on the theory of nuisance was incorrect. (Duss-Florida) W71-04532

BARNES V PECK (ADDITIONAL USE OF WATER RIGHTS CONDEMNED FOR AUGMENTATION OF CITY WATER SUPPLY). 187 NE 176-182 (Mass 1933).

Descriptors: *Massachusetts, *Water supply, *Eminent domain, *Water rights, Damages, Compensation, Water utilization, Administrative agencies, Easements, Rivers, Streams, Land, Legislation, Domestic water, Construction, Cities, Waterfalls, Electric power, Reasonable use, Legal aspects, Judicial decisions, Adjudication procedure, Condemnation, Hydroelectric power.

Plaintiffs sought to invalidate the taking of land by defendant city and defendants claiming through the city. The land was taken to increase the city's water supply. Plaintiffs contended that the taking of land and water rights was illegal in that: (1) the state statute authorizing the taking was not complied with, and (2) the city exceeded its rights in the water by using it to generate electricity for sale. Plaintiffs had been awarded damages for the taking but had refused them. The lower court dismissed plaintiffs' actions and the Supreme Judicial Court of Massachusetts affirmed. All of plaintiffs' constitutional and statutory rights were protected and complied with by the city in the taking. The city did not exceed its water rights by generating and selling

electricity. The statutory authority for the taking of the water encompassed uses other than the principal one of increasing the water supply. The city's development of electricity was incidental to the main purpose of increasing its water supply and was therefore within the statute authorizing the increased water supply. (Duss-Florida) W71-04539

MANAGEMENT AND ADMINISTRATION OF GROUNDWATER IN INTERSTATE AND INTERNATIONAL AQUIFERS, PHASE I, Bittinger (M. W.) and Associates, Inc., Fort Col-

lins, Colo.
For primary bibliographic entry see Field 04B.
W71-04541

CONTROL OF SPILLAGE OF HAZARDOUS POLLUTING SUBSTANCES, Battelle Memorial Inst., Richland, Wash. Pacific

Northwest Labs.
For primary bibliographic entry see Field 05G.
W71-04615

FLORIDA GRAVEL CO V CAPITAL CITY SAND AND GRAVEL CO (OWNERSHIP OF BED OF STREAM).

154 SE 255-257 (Ga 1930).

Descriptors: *Georgia, *Ownership of beds, *Gravels, *Navigable waters, Non-navigable waters, Navigable rivers, Rivers, Beds, Beds under water, Boundary disputes, Boundaries (Property), Land tenure, Real property, Streams, Judicial decisions, Legal aspects, Navigation, Easements, Sands, State governments.

Plaintiff gravel company sought to enjoin defendant sand company from removing sand and gravel from lands below the low water mark in a riverbed. Plaintiff was a lessee of the disputed lands and asserted that his lessor's title extended to the thread of the stream. The Supreme Court of Georgia categorized streams into three types: (1) wholly private; (2) beds owned privately, but subject to a public easement to use the stream as a highway; and (3) wholly public watercourses, in which the tide ebbs and flows. Determining that the stream in question was the second type, since it had no tides but was navigable in fact, the court held that plaintiff's lessor's title extended to the thread of the stream and that plaintiff had the exclusive right to mine sand and gravel from the river bed on the leased property. (Hart-Florida) W71-04624

SANTEE RIVER CYPRESS LUMBER CO V EL-LIOTT (BOUNDARIES OF SWAMPLAND). 150 SE 683-691 (SC 1929).

Descriptors: *South Carolina, *Land tenure, *Boundaries (Property), *Swamps, Boundary disputes, Real property, High water mark, Lumber, Lumbering, Judicial decisions, Legal aspects.

Plaintiff landowner sought damages and an injunction because defendant cut timber on plaintiff's land under claim of right. At trial the case devolved into an issue of title and possession of a portion of the disputed lands, which were bounded by the high water mark of a swamp. Plaintiff appealed from a verdict and judgment for defendant. Error was alleged in the lower court's charge to the jury as to the definition of 'high water mark'. The trial court had defined 'high water mark' as 'a mark or appearance on the ground made by, and the result of, usual high water—it means a difference in soil or growth or both and does not refer to temporary floods unusual and brief which may cover large areas'. The Supreme Court of South Carolina held that the trial court had not erred in defining high water mark for the jury. (Hart-Florida)

THE FEDERATION AND PURE WATERS. For primary bibliographic entry see Field 05G.

AMEND THE WATERSHED PROTECTION AND FLOOD PREVENTION ACT.

Hearings, Subcomm on Conservation and Credit, Comm on Agriculture, US House of Reps, 89th Cong, 1st Sess, Oct 11, 1965, p 69-82.

Descriptors: *Legislation, *Watershed Protect, and Flood Prev. Act, *Multiple-purpose projects, *Water utilization, Watersheds (Basins), Water supply, Dams, Flood protection, Flood control, Wildlife management, Reservoirs, Cities, Management, Recreation, Fish management, Irrigation water, Water management (Applied), Wildlife, Floodwater, Upstream reservoir sites, Reservoir shortage, Project benefits, Cost-benefit analysis, Costs, Acreage. Identifiers: *Floodwater detention capacity.

Hearings before the Subcommittee on Conservation and Credit of the House Committee on Agriculture were held for the purpose of considering amendments to the Watershed Protection and Flood Prevention Act. Considered were H.R. 2468, H.R. 4812, H.R. 5149, H.R. 9149, H.R. 9917, and H.R. 10241-all of the 89th Congress, first session. The Watershed Protection and Flood Prevention Act limited the size of dams to a flood-detention capacity of 5000 acre-feet. At the same time it allowed a 25,000 acre-feet capacity for reservoirs from which water was available for municipalities, fish and wildlife development, irrigation, and recreation. Unless the dams were located upstream where water supply was inadequate to permit multiple-purpose development it was impossible for such small dams to hold back sufficient floodwater for the full allowable reservoir capacity of 25,000 feet. The amendments considered increased the limitation on floodwater detention capacity from 5,000 to 12,500 acre feet, thereby providing for the full utilization of available reservoir sites for multiple-purposes. Moreover, increasing the limitation on floodwater detention capacity to 12,500 acrefeet would also result in reduction of overall project costs and increase the benefits in some watersheds. (See also W71-04642) (Duss-Florida) W71-04641

WATERSHED PROJECTS.

Hearings, Subcomm on Conservation and Credit, Comm on Agriculture, US House of Reps, 89th Cong, 1st Sess, March 16, 17, July 20, 22, Aug 30, Sept 21, 22, Oct 11, 1965. 253 p.

Descriptors: *Flood protection, *Watersheds (Basins), *Flood control, *Legislation, Project purposes, Project planning, Watershed management, Channel improvement, Stream improvement, Crop production, Federal government, Local governments, State governments, Financing, Public lands, Land use, Flood damage, Cost-benefit analysis, Coordination, Structures.

Hearings before the Subcommittee on Conservation and Credit of the House Committee on Agriculture were held to consider watershed projects submitted and recommended by the Department of Agriculture. States in which projects were ment of Agriculture. States in which projects were to be located included: Alabama, Arkansas, Arizona, California, Florida, Indiana, Iowa, Kansas, Louisiana, Mississippi, Nebraska, Nevada, New Jersey, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, Mest Virginia, and Wicconsin. The purpose ginia, West Virginia, and Wisconsin. The purpose of these projects was primarily flood prevention. In many of the districts where cropland predominated over other watershed land uses, there was considerable flood damage, resulting in high production costs and low crop yields. In general, flooding contributed to overall underdevelopment in the watersheds and surrounding communities. Therefore, there was a need for assistance from the federal government to the various districts in order

to prevent such flood damage. Many projects demonstrated cooperation between the federal government, state governments and local governments, with reference to financing and planning. (See also W71-04641) (Duss-Florida) W71-04642

A BEGINNERS GUIDE TO RESEARCH IN NATURAL RESOURCES LEGISLATION AND POLICY DEVELOPMENT.

Central Washington State Coll., Ellensburg. K. A. Hammond, and Carolyn Willberg. December 1969. 54 p, 6 ref. OWRR Project B-019-WASH (3).

Descriptors: *Natural resources, *Legislation, *Publications, *Information retrieval, Methodology, State governments, Federal government, Legal aspects, Judicial decisions, Local governments, Water resources development, Political aspects, Administrative agencies, Washington, Data collection, Research and development, Bibliographies, Conferences, Documentation, Libraries, Technical societies.

Identifiers: *Legislative history, *Public policy.

Designed as a manual for student use, this guide provides an approach to research in natural resources legislation and policy development. The guide is suited to researching specific legislation as well as general topics and points out that political bias must be considered in researching legislative history. At the federal level, the manual presents guides for tracing the history of bills and resolutions from their introduction through committee hearings and reports to congressional debate and enactment. Use of the Congressional Record is examined, and procedures for locating and obtaining legislative documents are outlined. The manual also examines the use of statutes, executive documents, general reference sources, agency publications, and publications of private interest groups. Part II covers resources legislation at the state level, where documentation is often incomplete or nonexistent. Much state material is never documented or published; therefore, specific information requests and interviews are primary sources of material in state research. Using the state of Washington as an example, the manual discusses sources dealing with legislative history, statutes, judicial decisions, attorney general's opinions, legislative reviews, municipal ordinances and voting information. (Liptak-Florida) W71-04645

PERMITS FOR DISCHARGES OR DEPOSITS INTO NAVIGABLE WATERS.
Corps of Engineers, Washington, D.C.

Federal Register, Vol 36, No 14, Thursday, January 21, 1971, p 983-984.

Descriptors: *Water quality control, *Permits, *Rivers and Harbors Act, *Administrative decisions, Navigation, Waste disposal, Navigable waters, United States, Water quality, Public health, Water pollution, Water pollution sources, Water resources, Legislation, Water pollution abatement, Administration, Administrative agencies, Decision making, Water policy, Effluents, Wastes, Regulation, Waste water (Pollution).

Identifiers: *Environmental Policy Act, *Corps of Engineers.

In recognition of the duties of the Secretary of the Army under the Refuse Act of 1899 and of the responsibilities of the Environmental Protection Agency (EPA) under the National Environmental Policy Act of 1969, the Secretary proposed a memorandum of understanding between the Secretary and the EPA to guide the Corps of Engineers in implementing the Refuse Act permit program. The Corps' policy will be to coordinate with the EPA all applications for permits to discharge refuse into navigable waters. The EPA will advise the Corps of the impact of the proposed discharge on water quality standards and the EPA's findings will

be conclusive. The memorandum establishes procedures for application, state certification under the Federal Water Pollution Control Act, and guidelines to be considered by the EPA in processing applications. In the absence of objection from the EPA, the Corps may deny a permit only if it impairs navigation or adversely affects fish and wildlife resources under the meaning of the Fish and Wildlife Coordination Act. The Corps will also consult the EPA before adopting rules, regulations, policies, or procedures under the Refuse Act or relating to the memorandum. Permits shall require compliance with applicable water quality standards, provide for suspension or revocation for non-compliance or changed conditions adversely affecting water quality standards, permit inspection and sampling, and provide for periodic reports on the nature and quantity of refuse discharged. (Liptak-Florida) W71-04646

FINANCIAL RESPONSIBILITY FOR OIL POL-LUTION CLEANUP.

Federal Maritime Commission, Washington, D.C.

Federal Register, Vol 36, No 14, Thursday, January 21, 1971, p 996-997.

Descriptors: *Ships, *Oil, *Administrative decisions, *Insurance, Water pollution control, Pollution abatement, Federal government, United States, Water pollution, Water quality control, Water pollution sources, Legislation, Administration and Political Po tion, Administrative agencies, Decision making, Legal aspects, Risks, Compensation, Damages, Adjudication procedure, Remedies.

Identifiers: *Oil spills, *Water Quality Improvement Act.

In order to implement the financial responsibility provisions of section 11 (p) (1) of the Federal Water Pollution Control Act, the Federal Maritime Commission adopted regulations requiring owners of vessels exceeding 300 gross tons to evidence their financial responsibility to meet potential liability to the United States resulting from oil discharges in United States' waters. The Act permits direct action against the insurer or underwriter and allows the insurer to raise all defenses the owners could have raised. To implement this provision, the Federal Maritime Commission regulations set out a uniform policy endorsement, certificate of insurance, surety bond form, and guarantee form in which the insurer agrees to direct action. Upon the objection of several underwriters that the language of the standard forms was subject to possible misinterpretation regarding the extent of rights and defenses available to the insurer, the Commission gives notice of proposed adoption of clarifying language in the regulations. The changes will make the new language optional with the insurer, and the Commission may accept either the original or alternative language. (Liptak-Florida) W71-04647

SOME RECENT DEVELOPMENTS CONCERN-ING FISHING AND THE CONSERVATION OF THE LIVING RESOURCES OF THE HIGH SEAS,

California Univ., San Diego. Inst. of Marine Resources

Milner B. Schaefer.

San Diego Law Review, Vol 7, No 3, p 371-407, July 1970. 106 ref.

Descriptors: *Marine fisheries, *Conservation, *International law, *International waters, Law of the sea, Legal aspects, Treaties, Continental Shelf, Marine animals, Marine fish, Commercial fishing, Oceans, Exploitation, United States, Foreign countries, United Nations, International commissions, Navigation, Aquatic life, Crustaceans, Fish, Fish conservation, Beds. Identifiers: *Territorial seas.

Discussing current developments concerning fishing and conservation of living resources in the high

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seas, this article focuses upon the problems of the present international legal framework and the recent activities of nations in international fishery affairs. Particular emphasis is given to the practice and policy of the United States. The present legal framework is made up of the four conventions adopted at the 1958 International Conference on the Law of the Sea. These conventions concern: (1) the high seas, (2) the territorial sea and the contiguous zone, (3) the Continental Shelf, and (4) fishing and conservation of living resources of the high seas. The author notes that these conventions are inadequate in that they do not: (1) establish limitations on the use of resources, (2) specify who is to have access to resources on the high seas, (3) specify who should prescribe policies regarding access, and (4) establish procedures whereby disputes over policies may be settled. The conven-tion on Fishing and Conservation is particularly weak because few nations have ratified it. Regarding recent developments, the author discusses nations' claims of exclusive jurisdiction over living resources in coastal waters and in Continental Shelf waters. Current problems in what constitutes conservation of resources are considered. Finally, the author examines methods employed in settling disputes between nations and proposals for a more uniform system in the future. (Duss-Florida) W71-04648

THE THEORY AND PRACTICE OF INTERNATIONAL FISHERY DEVELOPMENT-MANAGEMENT.

Ralston Purina Co., St. Louis, Mo. Wilbert McLeod Chapman. San Diego Law Review, Vol 7, No 3, p 408-454, July 1970. 83 ref.

Descriptors: *Marine fisheries, *Fish conservation, *International commissions, Law of the sea, *International law, Fish management, Fisheries, United Nations, Treaties, Exploration, Exploitation, Technology, Economics, Regulation, Oceans, Commercial fisheries, Fish behavior, Migration patterns, Research and development, Fish populations, Environment, Environmental effects, Seas, Legal aspects.

Because of the rapid development of the marine fishing effort on a world-wide basis, the author of this article sees a great need for marine fish conservation and management. The article focuses upon the present international machinery for fishery regulation and seeks to assess its efficacy--whether it needs strengthening or whether an entirely new international framework should be established. Among the existing international fishery commissions and bodies discussed are: (1) the International Commission for the Exploitation of the Sea; (2) the Fur Seal Convention; (3) the International Pacific Halibut Commission and similar conventions; (4) the International Whaling Commission; (5) the Indo-Pacific Fisheries Council, and the Food and Agriculture Organization of the United Nations; (6) the International Commission for the Northwest Atlantic Fisheries; (7) various restric-tive fishery conventions; and (8) various fishingrights agreements between nations. The author emphasizes the importance of scientific analysis of fish populations in the area of conservation. He concludes that existing organizations have contributed much in the way of mitigating disputes between nations and improving our knowledge of the ocean, its resources, and fishing. However, the author does see the need for a major overhaul of the United Nations machinery for dealing with ocean-oriented problems. There is particular need for improved funding of scientific research into fishing problems. (Duss-Florida) W71-04649

INTERNATIONAL AND NATIONAL REGULATION OF POLLUTION FROM OFFSHORE OIL PRODUCTION,

Nospaman, Waters, Scott, Krueger and Riordan, Los Angeles, Calif. Robert B. Krueger. San Diego Law Review, Vol 7, No 3, p 541-573, July 1970. 33 p, 138 ref.

Descriptors: *Water pollution, *Oil industry, *Offshore platforms, *Exploitation, Legislation, Oil wells, International law, International waters, Natural gas, Oil, Oil fields, Exploration, Water pollution sources, Water pollution effects, Water pollution control, Pollutants, Pollution abatement, Administrative agencies, Water Quality Act, Legal aspects, Regulation.

Identifiers: Outer Continental Shelf Lands Act, Oil spills.

The petroleum resources available on the Continental Shelf and their relation to world supply are examined by this article to show that exploitation of offshore petroleum is necessary. The author discusses in detail the various international conventions establishing agreements between riparian nations to pevent oil pollution. President Nixon proposed to the United Nations that all nations adopt a treaty renouncing claims over natural resources of the seabed beyond the point where the high seas are 200 meters deep and agree to regard these resources as the 'common heritage of mankind.' The author analyzes considerations for and against the President's proposal, pointing out that underdeveloped nations are relatively unconcerned about pollution. It is also suggested that pollution from offshore wells is not nearly so disastrous as a wrecked oil tanker, such as the Torrey Canyon. The author concludes that techniques are available and can be developed which would greatly reduce any chance of spillage from offshore wells. In addition, the Outer Continental Shelf Lands Act, the Water Quality Improvement Act, and the National Environmental Improvement Act are examined as means of preventing pollution. (Hart-Florida) W71-04650

OCEAN POLLUTION: AN EXAMINATION OF THE PROBLEM AND AN APPEAL FOR INTERNATIONAL COOPERATION,

Douglas D. Busch, and Edward I. Mears. San Diego Law Review, Vol 7, No 3, p 574-604, July 1970. 31 p, 94 ref.

Descriptors: *Oceans, *Water pollution, *Water pollution control, *International waters, International law, International commissions, Pollution abatement, Water pollution sources, Water pollution effects, Estuaries, Water pollution treatment, Pollutants, Public health, United States, Foreign waters, Thermal pollution, Non-structural alternatives, Oil, Oily waters, Pesticides, Pesticide residue, Pesticide drift, Pesticide removal.

Identifiers: *International cooperation, *Ocean pollution.

Emphasizing that man's survival depends upon the oceans, this article notes that man can no longer ignore ocean pollution. The impact of pollution upon estuaries and the high seas is considered first, wherein the author notes that many marine organisms depend upon clean estuaries during part of their life. Marine pollution is next considered. The author discusses in detail specific pollutants, sources, and the effects of pesticides and petroleum. The analysis of sources includes an examina-tion of the polluting effects of man's land activities, man's surface activities, and man's exploitation of sea resources. To solve the ocean pollution, there is a need for international cooperation. Present treaties are inadequate, and United Nations regulation of international pollution is difficult. The problem of defining what pollution is to be abated on an international level is examined. Whether regional or international control would be a better method of pollution control is briefly considered. The author concludes with fourteen recommendations for controlling ocean pollution. (Hart-Florida) W71-04651

PROPERTY--WHARFING OUT--RIPARIAN OWNER PERMITTED TO USE FILLED-IN

SWAMP AS A WHARF TO REACH NAVIGABLE WATER,

Jack L. Schoellerman.

San Diego Law Review, Vol 7, No 3, p 684-689, July 1970. 38 ref.

Descriptors: *Landfills, *Riparian rights, *Riparian land, *Access routes, Accretion (Legal aspects), Judicial decisions, Docks, Boundaries (Property), Boundary disputes, Land tenure, Real property, Navigable waters, Land forming, Public health, Mosquitoes, Lagoons, Legal aspects, Piers, Swamps. Identifiers: *Wharfage.

In Burns v Forbes, 412 F2d 995 (3rd Cir 1969). plaintiff riparian landowner filled in the lagoon in front of his land to gain access to navigable water and to abate mosquito proliferation. Defendant, a contiguous landowner, fenced across plaintiff's landfill and cut off plaintiff's access to the navigable waters. Plaintiff sued to enjoin defendant from maintaining the fence. The trial court held that plaintiff did not have title to the filled land and dismissed the action. On appeal, the Third Circuit Court of Appeals reversed and held that while plaintiff did not own the land he created, the landfill was to be considered an exercise of plaintiff's riparian right to wharf to navigable waters. A judgment was entered directing defendant to remove the fence. This case comment praises the Burns decision as an imaginative solution. The court reasoned that since a riparian owner cannot create an accretion and acquire title to it, the landfill must be public. Since the landfill is public, the comment raises a question as to the quantity of the rights in the fill which inhere to the public. (Hart-Florida) W71-04652

THE CONTINENTAL SHELF'S OUTER BOUNDARY-A POSTSCRIPT,
Naval War Coll., Newport, R.I.

L. L. E. Goldie.

Journal of Maritime Law and Commerce, Vol 2, No 1, p 173-178, Oct 1970. 6 ref.

Descriptors: *Continental Shelf, *Continental Margin, *Jurisdiction, *International law, Law of the sea, Boundary disputes, Boundaries (Property), International waters, Treaties, Foreign waters, Political aspects, Governments, Foreign governments, Coasts, Political constraints, Coordination, Administration, Oceans, Legislation, Legal aspects.

Discussed in this article is the viability of proposed alternative regimes to govern the zone between the outer limits of the Continental Shelf and the Continental Rise. The following international legislative blueprints, suitable to varied coastal state situations, are advocated by the author: (1) bringing such zones within the coastal state's regime where a clear claim exists to the appurtenant zone, (2) bringing the zone under an international regime while leaving its administration in the coastal state's hands, (3) co-operative administration among coastal states where overlapping claims exist, and (4) entirely international regimes where political realities make co-operation impossible. The relative merits of the author's scheme are examined in light of the Stratton Commission's proposals, the scheme's political marketability, and its stabilizing potential on international politics. (Earl-Florida)

TWO NEGLECTED PROBLEMS IN DRAFTING REGIMES FOR DEEP OCEAN RESOURCES. American Journal of International Law, Vol 64, No 5, p 905-9 19, Oct 1970. 50 ref.

Descriptors: *Water resources development, *Law of the sea, *International law, *Oceans, Legal aspects, International commissions, Continental Shelf, Resources, Regulation, Ownership of beds, Exploitation, Exploration, United Nations, Treaties, Mineralogy, Relative rights, Beds under water. Identifiers: Ocean resources.

Water Law and Institutions—Group 6E

Considering two essential yet neglected legal aspects of proposals for international regimes to govern deep-ocean resources, the author of this article discusses: (1) the legal quality of title that a state may have over deep-ocean resources, and (2) means of assuring transnational recognition of title to deep-ocean resources. To illustrate these points, the author critically evaluates the Stratton Commission Report which sought to redefine the Continental Shelf, establish intermediate zones beyond the shelf, and establish an international framework for registering claims to resources and for financing research and development of resources. The chief problem with the quality of title under the Commission's registry authority is that it adopts a 'firstcome, first-registered' system and is not so much a claims-registration regime as a mere recording one. As for transnational recognition of title, the Commission failed to specify whether it favored a fullfaith-and-credit or national treatment of foreign titles. A model developed from analogies to the requirements of recognition of perfected security interests under the Uniform Commercial Code might be preferable to either system. (Duss-Florida) W71-04654

MEADOWLANDS REGIONAL DEVELOPMENT AGENCY V STATE (VALIDITY OF STATE RECLAMATION AND DEVELOPMENT ACT).

112 NJ Super 89, 270 A2d 418-443 (1970).

Descriptors: *New Jersey, *Legislation, *Reclamation, *Environment, Water pollution, Balance of nature, Waste disposal, Solid wastes, Waste treatment, River basins, Marshes, Cities, Sewage treatment, Legal aspects, Judicial decisions, Grasslands, Land, Land use, Land reclamation, Environmental effects. New York.

Plaintiffs sought to invalidate a statute which provided for reclamation and development of meadowlands located in New York and northeastern New Jersey. Among the objectives of the statute were: (1) to protect the area from air and water pollution, (2) to provide solid waste disposal, and (3) to preserve the balance of nature. Plaintiffs attacked the act principally upon constitutional grounds, alleging, among other things: (1) that the act was a special rather than general law, (2) that there were improper delegations of power, and (3) that it violated various sections of the New Jersey and United States Constitutions. The Superior Court of New Jersey found the act valid in all respects. (Duss-Florida)

AN ACT TO CREATE AN AGENCY OF EN-VIRONMENTAL CONSERVATION. Laws of Vermont, No 246, 1969 Adjourned Session (1970).

Descriptors: *Vermont, *Environment, *Administrative agencies, *Conservation, State governments, Administration, Water resources development, Coordination, Governments, Legislation, Legal aspects, Leadership, Supervisory control (Power), Regulation, Decision making.

An agency of environmental conservation is hereby created, composed of the following pre-existing state agencies: (1) fish and game department; (2) forests and parks department; (3) environmental board; (4) division of protection; (5) recreation board; (6) committee on natural resources; (7) water resources department; and (8) natural resources council of the department of agriculture. The functions of these subdivisions are advisory only, with the administrative, policy making, rule making, and regulatory functions vested in the secretary of the newly consolidated agency. The secretary is appointed by the governor. His duties are to plan, coordinate, and direct the functions vested in the agency, and to appoint the commissioner of each subdivision. The rules and regulations of the sub-agencies are transferred to the consolidated agency. (Hart-Florida)

WHOLESALE LAUNDRY BD OF TRADE, INC V CITY OF NEW YORK (CONSTITUTIONALITY OF INCREASED WATER RATES). 315 NYS2d 715-717 (Sup Ct 1970).

Descriptors: *New York, *Water rates, *Administrative decisions, *Local governments, Public utilities, Water supply, Cities, Regulation, Administrative agencies, Administrative decisions, Water users, Utilities, Legal aspects, Judicial decisions, Costs.

Plaintiff laundry corporations sought to restrain defendant city from enforcing increased water rates promulgated by the Administration of Environmental Protection and approved by the Board of Estimate. The state constitution provided that local government may make a fair return on the value of property used in the operation of public utilities. Profit was allowed in addition to the cost of service and taxes which would be paid to local governments if the service were privately owned. Plaintiffs contended that the proposed increase would give the city an excessive return. Defendant alleged that the increase would not bring about an excessive return. The Supreme Court of New York County granted defendant summary judgment. The return on the city's investment would not exceed the fair legal rate of return as set by the Banking Board. (Duss-Florida)

FRIEDLAND V STATE (LIABILITY OF STATE FOR ALTERING FLOW OF STREAM). 314 NYS2d 935-938 (Sup Ct App Div 1970).

Descriptors: *New York, *Surface waters, *Alteration of flow, *Reasonable use, Diversion, Relative rights, Riparian rights, Streamflow, Watercourses (Legal), Riparian land, Surface runoff, Rainfall, Highways, Construction, Ponds, Flow, Natural flow doctrine, Land, Land tenure, Percolating water, Surface drainage, Channels, Damages, Judicial decisions, Legal aspects.

Plaintiff landowners sought damages from defendant state for interference with a stream which fed a pond on plaintiffs' land. Defendant had constructed a highway, thereby diverting and rechan-neling the stream which passed through plaintiffs' property. Plaintiffs contended that these acts so altered the discharge of surface water that, depending on the amount of rainfall, algae formed in the pond or the pondwater became stagnant. The Supreme Court of New York reversed a lower court decision for plaintiffs. The court applied several principles of law to the facts of this case, including: (1) the right of a landowner to divert streams flowing through his land so long as they are returned to their normal channel before reaching land of lower owners, (2) liability for willful diversion of water onto neighboring land, (3) the equal rights of upper and lower riparian owners to deal with surface waters on their property, (4) the amount of surface water which may be discharged into a natural watercourse after construction of municipal improvements, and (5) the right of a landowner to reasonably use percolating waters on his land. Applying these principles the court found that the record did not sustain liability on the part of the state. (Duss-Florida) W71-04658

OWEN V HUBBARD (BOUNDARY DISPUTE OVER TITLE TO BULKHEAD). 271 A2d 672-682 (Ct App Md 1970).

Descriptors: *Maryland, *Boundary disputes, *Riparian rights, *Bulkheads, Navigable waters, Relative rights, Land, Riparian land, Property (Boundaries), Permits, Easements, Channels, Legislation, High water mark, Banks, Shores, Accretion (Legal aspects), Construction, Tidal waters, Riparian waters, Legal aspects, Judicial decisions, Adjudication procedure, Remedies.

Plaintiff riparian landowners sought a declaratory judgment determining title to a portion of a bulk-

head constructed by defendant adjacent riparian landowners. Defendants constructed the entire bulkhead with plaintiffs' consent, and plaintiffs contended that their consent extended to construction of a leg of the bulkhead along their riparian property. Defendants contended that the boundary between the two properties showed that they did not construct any part along a riparian course owned by plaintiffs, and that, even if they had, plaintiffs' mere side rights should not prevail over defendants' right to use and possess the improvements they erected. The Court of Appeals of Maryland affirmed a lower court's decree for plaintiffs. A permanent easement for use and enjoyment of the bulkhead was granted defendants. Though the evidence was conflicting, the trial court's determination that plaintiffs' land behind the disputed bulkhead was riparian was not clearly erroneous. A Maryland statute grants riparian owners the exclusive right to make improvements into waters fronting their land. This statute is not susceptible to a construction prejudicing riparian rights where improvements are made on the side of riparian land. Title to that portion of the bulkhead extending in front of plaintiffs' land was thus in plaintiffs. (Duss-Florida) W71-04659

KENNY CONSTRUCTION CO V METROPOLITAN SANITARY DIST (SANITARY DISTRICT'S NONLIABILITY FOR CONSTRUC-TION COSTS IN EXCESS OF CONTRACT). 262 NE2d 842-850 (Ct App III 1970).

Descriptors: *Illinois, *Contracts, *Construction costs, *Sewers, Adjusted costs, Claims (Contracts), Change orders, Negotiations, Engineers estimates, Bids, Performance, Specifications, Contract administration, Drainage programs, Administration, Materials, Subsurface waters, Drainage systems, Tunneling, Sanitary engineering, Subsoil, Legal aspects, Judicial decisions, Construction materials. Identifiers: *Sanitary districts.

Plaintiff construction company sought recovery of additional costs incurred in sewer construction for defendant sanitary district. During construction plaintiff encountered allegedly unforeseen subsurface water. Plaintiff obtained defendant's written approval of certain changes in construction methods and material, but failed to obtain the contractually required written consent to treat such work as 'extra' and to submit written claims for extra costs within thirty days. Defendant appealed the trial court's award of recovery to plaintiff. Plaintiff, contending defendant's actions constituted waiver of the contractual requirements, cross-appealed, denying the adequacy of its award. The Appellate Court of Illinois held that the sanitary district's approval of changes in sewer construction methods and material did not constitute waiver of contractual conditions requiring written consent to extra costs for unauthorized work due to allegedly unforeseen subsurface conditions. Finding the plaintiff had been forewarned of possibly adverse subsurface conditions by both the contract and bid proposal, the court ruled the defendant not liable for plaintiff's extra costs. The lower court's award to plaintiff was reversed. (Earl-Florida) W71-04660

HENRY B BYORS AND SONS, INC V BOARD OF WATER COMM'RS (VALIDITY OF CHARGES IMPOSED AS A PRECONDITION TO MUNICIPAL WATER SERVICES).

264 NE2d 657-664 (Mass 1970).

Descriptors: *Massachusetts, *Water demand, *Water pressure, *Water rates, Water costs, Water supply, Contracts, Water distribution (Applied), Water conveyance, Distribution, Domestic water, Institutional constraints, Permits, Installation costs, Administration, Administrative agencies, Land tenure, Public utilities, Legal aspects, Judicial decisions.

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Plaintiff plumbing subcontractor sought a judicial determination of the validity of, and liability for, a charge imposed by defendant municipal water commissioners as a condition precedent to providing water services. The charge was imposed to meet the costs of maintaining adequate water pressure and supply in light of the cumulative effect of new construction. Plaintiff contended the charge was unauthorized, unreasonable and discriminatory, and denied liability under a contract requiring him to pay all necessary costs. Defendants asserted that such a 'demand charge' was within their statutory authority. The Supreme Judcial Court of Massachusetts held that: (1) municipal water commissioners have the authority to demand a charge before allowing connections into a municipal water main; (2) water charges need not be based entirely on the amount of water used; (3) reasonable discretion may be exercised in determining the terms of an extension of municipal water lines; (4) absent controlling contractual stipulations, a property owner is liable for water service and related charges. The court decreed the defendants' charge to be reasonable and valid. However, the property owner and not plaintiff subcontractor was liable for the payment of the charge. (Earl-Florida) W71-04661

SISSELMAN V SMITH (AUTHORITY OF COAST GUARD TO ISSUE BRIDGE-CONSTRUCTION PERMITS).

432 F2d 750-755 (3rd Cir 1970).

Descriptors: *United States, *Bridge construction, *Permits, *Legislation, Federal jurisdiction, Administrative agencies, Administration, Administrative decisions, Federal government, Navigation, Navigable waters, Canals, Navigable rivers, Adjudication procedure, Decision making, Coast Guard regulations, Institutional constraints, Construction, Legal aspects, Judicial decisions.

Identifiers: *General Bridge Authority Act.

Plaintiff canal owners, on grounds of impairment of navigation, sought to block the issuance of bridge construction permits by defendant Coast Guard commandant. Plaintiffs' canal had been constructed under legislation reserving in Congress the right to alter its navigable use. Defendant issued the permits pursuant to the General Bridge Authority Act of 1946. Plaintiffs contended that, in light of Congresses' reserved authority under the prior statute, defendant was without authority to issue the permits. The Third Circuit Court of Appeals held that the General Bridge Authority Act was intended to end piecemeal congressional supervision of bridge construction under prior legislation and, absent contrary language in pertinent statutes, there is no right to cross examination or notice in proceedings for the issuance of bridge permits by the United States Coast Guard. Determining that sufficient evidentiary support existed to uphold the defendant's determination that the alleged impairment to navigation was more theoretical than real, the court ruled that the power reserved to Congress by the prior statute had been delegated to the defendant. Summary judgment in favor of defendant affirmed. (Earl-Florida) W71-04662

UNITED STATES V TANKER MONSOON (RECOVERY FOR WRONGFULLY IMPOSED OIL POLLUTION CLEAN-UP COSTS).

433 F2d 95-98 (1st Cir 1970).

Descriptors: *Oil, *United States, *Water pollution, *Ships, Pollution (Stream), Stream pollution, Oily water, Navigable waters, Navigable rivers, Admiralty, Federal government, Harbors, Water pollution sources, Pollutants, Pollution abatement, Judicial decisions, Legal aspects, Legislation, Remedies.

Identifiers: *Oil Pollution Act, *Oil spills.

Plaintiff oil tanker sought recovery of oil-clean-up expenses incurred after the United States libeled

her and charged her with violation of the Oil Pollution Act of 1924. Evidence at trial established that the tanker had not caused the pollution. Plaintiff alleged that the government's negligence in charging her entitled her to recovery of clean-up costs. The United States denied negligence, asserted governmental immunity, and denied the imposition of a penalty or the receipt of money. The United States Circuit Court of Appeals for the First Circuit held that where the government negligently charges a tanker with pollution and demands she clean up oil spillage or be billed for the government's expense, the tanker electing to clean up is entitled to recovery of her costs under the Tucker Act, as a penalty wrongfully exacted by the government. The court determined that there was no probable cause to charge the plaintiff, and governmental tort immunity did not apply since a negligent lawsuit is not a tort. (Earl-Florida) W71-04663

CAROLINA BEACH FISHING PIER, INC V TOWN OF CAROLINA BEACH (ALLEGED TAKING OF LITTORAL LANDOWNER'S PRO-PERTY FOR CONSTRUCTION OF BERM).

177 SE2d 513-518 (NC 1970).

Descriptors: *North Carolina, *Eminent domain, *Berms, *High water mark, Land tenure, Boundary disputes, Riparian land, Beaches, Beach erosion, Tidal effects, Shores, Low water mark, Shore protection, Sea walls, Compensation, Piers, Intertidal areas, Navigable waters, Landfills, Cities, Legislation, Atlantic Ocean, Judicial decisions, Legal aspects.

Plaintiff littoral landowner sought to recover compensation for defendant town's alleged taking of property for a public purpose. In order to protect against beach erosion, defendant had constructed a berm along the ocean in front of plaintiff's property. Plaintiff alleged that the construction caused the loss of the use of his property and a fishing pier constructed in front of it. Defendant admitted construction of the berm, but alleged that the berm was located on land which had been divested from plaintiff through prior erosion by the ocean. The Supreme Court of North Carolina affirmed a lower court's nonsuit of plaintiff. In North Carolina a littoral landowner's property right extends only to the high water mark, although he has a right of access to the sea. The high water mark is generally computed in relation to the average high tide. Evidence showed that prior to construction of the berm, erosive action had placed plaintiff's land below the high water mark. The purpose of the berm was to provide protection from the sea and not to reclaim land along the beach for private owners. Therefore, title to the land was in the state, thus precluding plaintiff from obtaining compensation. (Duss Florida) W71-04664

HAMBURGER V UNITED STATES (GOVERN-MENTAL LIABILITY FOR SUBMERGED, IN-OPERATIVE SHOAL LIGHT). 318 F Supp 103-106 (D Md 1970).

Descriptors: *Federal government, *Navigation, *Buoys, *Shoals, Warning systems, Navigable waters, Hazards, Damages, Charts, Coast guard regulations, Accidents, Safety, Boats, Ships, Federal jurisdiction, United States, Judicial decisions, Legal aspects.

Plaintiff boat owner sought recovery from defendant United States for both personal injuries and property damage after striking the submerged remains of a shoal light. Defendant had marked the location of the remains with a warning light and had published a 'notice to mariners' after the shoal light's destruction was discovered. The United States District Court held that where a boat owner fails to note the absence of an aid to navigation, ignores a nearby warning light, and fails to consult available charts and notices, such actions con-

stitute the proximate cause of any subsequent collision with submerged remains of the absent navigational aid. Noting the defendant had fulfilled its duty to mark the remains of the submerged shoal light, the court entered judgment for defendant. (Earl-Florida)
W71-04665

RECREATION AND FISH AND WILDLIFE PROGRAM FOR THE STATE WATER PROJECT,

California State Dept. of Water Resources, Sacramento.

For primary bibliographic entry see Field 04A. W71-04684

KNIGHT V LEWARK (TRESPASS BY BUILDING DOCK IN BAY).

199 NC 407, 154 SE 624-625 (1930).

Descriptors: *North Carolina, *Ownership of beds, Bays, Docks, Beds, Beds under water, Prescriptive rights, Adjudication procedure, Legal aspects, Judicial decisions, Navigable waters.

Plaintiff riparian landowner sought to enjoin defendant from erecting a wharf and storehouse in the bay in front of plaintiff's land. Plaintiff alleged ownership of the bed of the bay. Defendant contended that plaintiff did not own the bed. At trial, the jury found that defendant had not trespassed upon plaintiff's land. Observing that the issue of trespass was properly decided by the jury, the Supreme Court of North Carolina affirmed the lower court judgment for defendant. The court furthermore observed that whether plaintiff could obtain an injunction on other grounds was immaterial, since the action was brought at law as trespass. (Hart-Florida)

HOLT V CITY OF WESTON (LIABILITY OF CITY FOR REFUSAL TO EXTEND DRAINAGE CULVERT). 157 SE 176-177 (W Va 1931).

Descriptors: *West Virginia, *Damages, *Cities, *Natural flow doctrine, Drainage, Water injury, Adjudication procedure, Condemnation, Eminent domain, Streams, Roads, Culverts, Surface drainage, Judicial decisions, Legal aspects.

Plaintiff landowner sought damages for defendant city's alleged negligence in failing to extend a drainage culvert across his land to a creek. The county had built a new road adjacent to plaintiff's tract and placed drains which altered the natural flow of surface water, causing unnatural quantities of water to flow onto plaintiff's land. Defendant, after its incorporation of plaintiff's land, refused to extend the drainage culverts across plaintiff's land to the creek. Plaintiff asserted that he sought recurring damages for an abatable nuisance, while defendant contended that plaintiff was asserting per-manent damages. The Supreme Court of Appeals of West Virginia noted that recurring damages could not be recovered from a public corporation, since the injured party possessed the right to receive the condemnation value for his injury. However, the court determined that plaintiff actually sought permanent damages in the nature of an inverse condemnation, for which the county, rather than defendant, was responsible. Accordingly, the court held that the lower court had properly sustained a demurrer to the complaint. Hart-Florida) W71-04730

IN RE WATER FRONT ON NORTH RIVER (CONDEMNATION VALUE OF RIPARIAN LAND AND BEDS UNDER WATER).
219 App Div 27, 219 NYS 353-366 (Sup Ct App Div 1926).

Water Law and Institutions—Group 6E

Descriptors: *New York, *Condemnation value. *Ownership of beds, *Docks, Eminent domain. Condemnation, Rivers, Beds, Beds under water, Riparian land, Riparian rights, Land tenure, Real property, Legal aspects, Judicial decisions, Cities. Compensation, Local governments.

Defendant reparian owner sought review of a condemnation award for his land taken in proceedings by plaintiff municipality. Defendant's condemned property was interposed between a street and river. Another tract across the street also belonged to defendant. Defendant asserted that: (1) compensation should have been allowed for pier and bulkhead rights; (2) use of the property for other purposes should have been considered in making the award; (3) consequential damages to the uncondemned parcels should have been allowed; and (4) allowance should have been made for conjunctive use of the condemned property with the uncon-demned parcel across the street. The Appellate Division of the New York Supreme Court held that compensation should have been permitted for pier and bulkhead rights held in fee by defendant despite legislation restricting exercise of the rights. As to the second contention, the court held that a landowner should receive the greatest value of his property for any purpose. In addition, the allowances given defendant for consequential damages and conjunctive use were upheld. (Hart-W71-04731

IN RE BELLEVUE HOSPITAL PSYCHOPATHIC PAVILION SITE IN CITY OF NEW YORK (CONDEMNATION VALUE OF SUBMERGED LANDS).

132 Misc 774, 230 NYS 411-421 (Sup Ct 1928).

Descriptors: *New York, *Condemnation value, *Beds under water, *Riparian rights, Roads, Highways, Cities, Beds, Ownership of beds, Eminent domain, Compensation, Payment, Judicial decisions, Legal aspects, Condemnation, Land tenure, Easements, Usufructuary right, Cranes,

Plaintiff city brought action to condemn riparian and submerged land allegedly belonging to defendant. The upland had been granted to defendant's predecessor-in-title on the condition that, on demand of plaintiff, he would construct and maintain a street fronting on the submerged property. The grant extended to the upland boundary of the proposed street. Construction of the street was never demanded by plaintiff. Defendant contended that he held an easement in the submerged property until such time as plaintiff sought construction of the street. Defendant therefore sought compensation for the condemnation of this easement. The Supreme Court of New York found that defendant held but a usufruct in the property and was not entitled to compensation therefor. Defendant also demanded compensation for the diminished value of his wharfage and cranage rights. The court held that since the proposed street would intervene between defendant's upland and the river, the value of his wharfage rights must be reduced by the amount necessary to construct a new bulkhead and otherwise render utilization of the claimed rights possible. Since such costs would equal the value of wharfage rights, no compensation was allowed for such rights. (Hart-Florida) W71-04732

WORK V BEACHLAND DEVELOPMENT CO (AUTHORITY OF SECRETARY OF THE INTERIOR TO RESURVEY RIPARIAN LAND). 19 F2d 699-702 (DC Cir 1927).

Descriptors: *Navigable rivers, *Surveys, *Administrative agencies, *Land tenure, Administrative decisions, Real property, Riparian land, Meanders, Boundaries (Property), Boundary disputes, Legal aspects, Judicial decisions, Administration, United States, Federal government.

Plaintiff development company sought to enjoin defendant Secretary of the Interior from resurveying certain riparian lands. The disputed lands had been surveyed by the United States and patented to plaintiff's predecessor. An interloper settled upon the land and applied to defendant for a survey, claiming that the lands were public and asserting his claim as a settler. Defendant's agent investigated the situation, and concluded that the original survey and meander were erroneous. However, other supervisory agents concluded that the original surveys were reasonably accurate and therefore resurvey was unnecessary. Nevertheless, defendant directed a new survey. Determining that defendant had no authority to resurvey lands which had already been conveyed by the United States, the Court of Appeals of the District of Columbia held that the original survey and its meanders were reasonably accurate and enjoined resurvey, noting that but for a contemplated township in the area, the resurvey request would probably not have been made. (Hart-Florida) W71-04734

OFFSHORE LANDS WITHIN BISCAYNE NA-TIONAL MONUMENT (OWNERSHIP OF LANDS OUTSIDE STATE'S THREE-MILE LIMIT),

Office of the Solicitor (Interior), Washington, D. C. Div. of Public Lands.

David E. Lindgen.

Memorandum Opinion to the Director, National Park Service, from Office of the Solicitor, Department of the Interior, Division of Public Lands, Jan 29, 1970.3 p.

Descriptors: *Ownership of beds, *Continental Shelf, *National monuments, *Reefs, Beds, Submerged Lands Act, Legal aspects, Judicial decisions, Legislation, Federal Government, United States, Florids, Public lands, Oceans, Natural resources, International law, Exploration, Exploita-

Responding to a request by the director of the National Park Service, this memorandum opinion from the Division of Public Lands discusses ownership of lands within the Biscayne National Monument lying outside the state of Florida's three-mile limit. The opinion makes four conclusions. First, the state of Florida, under the Submerged Lands Act, has exclusive jurisdiction over submerged lands within the Biscayne National Monument to a distance of three miles from its coastline. Second, under the Geneva Convention on the Continental Shelf, the United States has exclusive sovereign rights in the outer continental shelf, for purposes of exploration and exploitation of natural resources, seaward of the three-mile limit. However, these rights do not encompass ownership in its usual sense. Third, the location of the boundary lines between state and federal jurisdiction have not been finally adjudicated by the Supreme Court. Litigation involving location of the boundary is now before the Court. Finally, as decided in United States v Ray, 423 F.2d 16 (5th Cir 1970), two reefs within the Monument, but outside the three-mile limit, are part of the Continental Shelf and under United States jurisdiction. (Duss-Florida) W71-04735

SOMEBODY FOULED UP THE SEAS, Stephen Solomon. New Republic, Vol 163, p 21-23, Oct 31, 1970.

Descriptors: *Oceans, *Water pollution control,

*Water pollution sources, *Oil wastes, Water pollution, Pollutants, Water Quality Act, Water pollution effects, Pollution abatement, Non-structural alternatives. Oily water. Ships, Transportation, alternatives, Oily water, Ships, Transportation, Law of the Sea, Oil industry, Oil, International waters, Treaties, International commissions, International law, Regulation, Legislation.

Two international conventions aimed at curbing oil pollution on the oceans are discussed in this article. The Convention on Civil Liability for Oil Pollution

Damages sets the polluter's liability at \$134 per ton up to a ceiling of \$14 million for each ship involved in an oil spill. The author feels that the ceiling is too low in light of the size of the new super-tankers being built and urges that the oil industry, which reaps the profits from the huge tankers, should bear the cost of damages caused by oil spills. The convention only covers oil tankers, leaving other vessels free to pollute, and excepts ship owners from liability for acts of God, war, or acts of third parties. The author proposes delaying adoption of the Convention until the drafting is complete on a new treaty imposing virtually absolute liability with much higher limits on ship owners. The Convention on Intervention on the High Seas in Cases of Oil Pollution Casualties permits nations to act on the high seas to protect their coastlines from imminent danger. An amendment to a 1954 convention prohibits oil discharge on the high seas except for a certain amount per mile. The author argues that the prohibition should be absolute and the oil industry should be required to build on-shore dumping facilities. (Liptak-Florida) W71-04740

THE 'FINAL' WATER WELL LAW AND REGULATIONS (STANDARDS FOR WATER WELL CONSTRUCTION AND PUMP INSTALLA-TION), Ground Water Resources Inst.

Durward Humes.

Water Well Journal, Vol 20, p 3-11, Jan 1966. 1 tab. 9 ref.

Descriptors: *Public health, *Well regulations, *Water wells, *Legislation, Construction, Pumps, Pumping, Standards, Regulation, Well permits, Drilling, Administrative agencies, Administration, Groundwater, Water quality, Inspection, Installation, Well casings, Artesian wells, Well screens, Excavation, Water policy, Aquifers, Percolating water, Legal aspects.

Reflecting the desire of the well-manufacturing industry to protect public health and to upgrade construction standards in the industry, the Model Water Well Construction and Pump Installation Act prescribes state regulation of the well-construction industry. This report contains the proposed law, explanatory comments accompanying important sections, and proposed model administrative regulations. Also included is a table outlining standards for the construction of wells. The general scope of the Act is to prohibit construction of wells in violation of its applicable rules and regulations. The state department of health or some other appropriate agency would administer and enforce the Act, and the department would have the powers necessary to: (1) require permission and notification in designated areas before construction of water wells, abandonment of water wells, or installation of pumping equipment in any wells: (2) inspect water wells, abandoned water wells or pump installations; (3) license water well contractors; and (4) grant exemptions from the operation of the Act. Sections cover fees, procedures for enforcement, administrative hearings, judicial review and penalties for violations. The administrative regulations define more specifically standards and procedures under the Act. (Duss-Florida) W71-04742

ONONDAGA WATER SERVICE CO V CROWN MILLS, INC (UTILITY NEEDS TO CONDEMN ONLY AMOUNT OF WATER USED). 132 Misc 848, 230 NYS 691-704 (Sup Ct 1928).

Descriptors: *New York, *Condemnation, *Natural flow, *Condemnation value, Water supply, Legal aspects, Judicial decisions, Remedies, Damages, Eminent domain, Mills, Public utilities, Lakes, Streams, Riparian rights, Dams, Water storage, Public rights, State governments, Legisla-

Field 06—WATER RESOURCES PLANNING

Group 6E-Water Law and Institutions

Plaintiff water supply company sought to obtain by condemnation the right to withdraw six million gallons of water daily from a lake which fed a stream on which defendant operated his mills. Defendant claimed the reduction in flow would diminish the power at the mills and argued that as riparian owner he was entitled to the undiminished natural flow. The trial court ruled that a riparian owner did have the right to an unaltered flow of water past his property, but a state statute allowed condemnation of this right. Defendant also contended that the statute's language required condemnation of all of defendant's right to the flow, not merely part of it. The court noted this would mean payment as though the flow had stopped, despite the fact some water would still flow past defendant's property and the mills could still operate. The court said the language required condemnation only of the water taken. In fact, the court noted, the plaintiff under the statute could condemn the water only for public use, and since only six million gallons were needed for public use, plaintiff could not condemn more than that. The court ordered appraisers appointed. (Morris-Florida) W71-04745

UNWILLING HOST TO UNWANTED GUEST,

Nebraska Soil and Water Conservation Commis-

Warren D. Fairchild.

Water Spectrum, Army Corps of Engineers, p 24-29, Winter 1970.

Descriptors: *Water policy, Legal aspects, Research and development, *Flood plains, Research and development, *Floods, *Planning.

Identifiers: *Flood plain management, *Flood plain information.

Nebraska has been the victim of several disastrous floods in recent years, and consequently passed legislation which has become a model of flood plain regulation. The Nebraska Flood Plain Regulation Act delineates potential flooding areas within the flood plain, enforces zoning ordinances, and reviews and upgrades the program based on changing physical and technical conditions. Launching a new approach for the protection of communities must involve a public information program, therefore, the Nebraska Commission had sessions with city councils, used television announcements, and published pamphlets to inform the public. Possibly the most significant accomplishment growing out of the Nebraska experience has been the establishment of lines of communication among various federal and state agencies whose areas of responsibility overlap. The state legislature has not funded bethe Commission sufficiently, but the first steps have been taken to develop the flood plain regulation program. Also, the National Flood Insurance Program, 1968, will encourage cities to follow directions of Nebraska's flood regulation act. (Wray-Chicago) W71-04749

SYKES V SYKES (UPPER PROPRIETOR'S RIGHT TO ALLOW WATER TO DRAIN ONTO LOWER PROPRIETOR'S LAND).

197 NC 37, 147 SE 621-622 (1929).

Descriptors: *North Carolina, *Drainage, *Surface Descriptors: "North Carolina, "Drainage, "Surface runoff, 'Riddance (Legal aspects), Relative rights, Roads, Highways, Ditches, Legal aspects, Judicial decisions, Remedies, Surface drainage, Land, Real property, Runoff, Drainage water, Surface waters, Alteration of flow, Diversion.

Defendant filled a ditch on property adjacent to a road separating his property from plaintiff's, causing surface waters to drain onto and damage plaintiff's property. Defendant contended that the road was private and that the ditch was on his property. On court instructions to find for defendant if the road was private, the jury in the trial court found for defendant. Plaintiff excepted to the instruc-tions. The Supreme Court of North Carolina affirmed. Where a road is private, the land on either side belongs to adjoining landowners. Upper proprietors have the right to accelerate the flow of water from their land to land of lower proprietors, so long as they do not alter its natural direction of flow. In the instant case there was no evidence that the water was diverted from its natural course. Defendant was entitled to fill a ditch on his own property to facilitate drainage of his land. (Dye-Florida) W71-04750

COLORADO WATER CON-NORTHERN POLITICAL A SERVANCY DISTRICT: SYSTEM,

Colorado State Univ., Fort Collins. Dept. of Political Science

Stanley J. Bastian.

Master of Arts thesis, Dec 1970. 218 p, 4 fig, 8 tab, 69 ref. OWRR Project B-029-COLO (4).

Descriptors: *Systems analysis, *Administrative agencies, Decision-making, Water management, Colorado, *Water resources development, *Environment, Planning.

The Northern Colorado Water Conservancy District (NCWCD), a major water distributing agency on the East Slope of the Continental Divide in northeastern Colorado, is the focus of this study. The study treats (1) the environmental forces which generated political activity designed to provide a solution to the problem of water shortages within north-eastern Colorado, (2) the political actions which led to the formation of the NCWCD, and (3) the adaptations the NCWCD has made to imputs from its environment. The NCWCD is conceptualized and analyzed as a political system. The analysis is primarily based upon a search of the minutes of the NCWCD Board of Directors' meetings, agency reports, personal interviews, pertinent government documents, and newspaper articles relating to the structure and decision-making process of the NCWCD. This study relies heavily upon the minutes of the Board meetings for the major source of information used to analyze and characterize the NCWCD political system. The major findings indicate that formation of political systems is preceded by increasingly formal and in-tegrated political activity designed to reduce environmental stresses that cannot be handled by existing social systems. The activities and structural characteristics of a political system are determined by the primary goals pursued and the environmental forces which threaten or facilitate their realization. Political systems pass through identifiable stages of evolutionary development. As the environment changes, the goals, activities, and structural characteristics of the systems's decisionmakers are modified to permit the reduction of tension within the system and protection from external threats. (Wray-Chicago) W71-04752

PLANNING IN LOCAL WATER ORGANIZA-

TIONS, Colorado State Univ., Fort Collins. Dept. of Political Science.
Julian Pineda.

A Master of Arts thesis, Dec 1970. 97 p, 12 fig, 26 tab, 57 ref. OWRR Project B-051-COLO (1).

Descriptors: *Planning, Organization, Decision-making, *Water districts, Water resources develop-

Identifiers: Comprehensive planning.

The study is a comparative organizational analysis of the planning process in two types of local water distribution organizations, domestic water supply distribution organizations, domestic water supply and irrigation supply. The differences and the similarities in planning behavior are examined from two perspectives: (1) the type of the organization, and (2) the size of the organization. The analysis was based upon data obtained from a ten per cent sample of each of the two types of organizations in an area of high population density. Persons who

were responsible for organizational planning were contacted and interviewed. The data was secured through the use of a standardized questionnaire designed to measure the extent to which organizations engaged in planning. The findings evidenced a strong linkage between the type and size of the organizations and the patterns of organizational planning behavior. It was found that these relationships existed along three dimensions. First, organization type was related to organizational planning behavior. Domestic water organizations devoted more attention to organizational planning activities than did the irrigation organizations. Second, organization size showed a definite relationship to planning behavior. More attention was devoted to planning in the larger irrigation and domestic organizations than in smaller organiza-tions. Third, a definite relationship was found to exist between organization type, organization size, and planning behavior. (Wray-Chicago) W71-04754

SYSTEMS ANALYSIS, WATER QUALITY AND GOVERNMENT DECISION MAKING,

New York State Dept. of Health, Albany. Environmental Health Services.

For primary bibliographic entry see Field 06A. W71-04766

ANDERSON V MCCULLEY (DAMAGES FOR OBSTRUCTING SURFACE DRAINAGE).

225 NW 152 (Minn 1929).

Descriptors: *Minnesota, *Obstruction to flow, *Drainage systems, *Surface drainage, Drains, Floods, Flood damage, Land, Land tenure, Relative rights, Surface waters, Surface runoff, Damages, Legislation, Legal aspects, Judicial decisions, Crops.

Plaintiff farmer, seeking to recover damages, alleged that defendant landowner had negligently obstructed a drainage ditch so that water was held on plaintiff's land, damaging his crops. The jury returned a verdict for plaintiff, and defendant ap-pealed, challenging the sufficiency of the evidence. The Supreme Court of Minnesota affirmed. The evidence showed that defendant obstructed the drainage ditch in disregard of plaintiff's rights, as the ditch was part of a public drainage system. One who negligently obstructs a public drain to the damage of his neighbor is liable for damages. (Morris-Florida) W71-04769

HOWLAND V UNION BAG AND PAPER CORP (CONDEMNATION OF LAND ALONG STREAM DOES NOT DEPRIVE RIPARIAN OWNER OF TITLE TO BED NOR RIPARIAN RIGHTS). 156 Misc 507, 282 NYS 357-367 (Sup Ct 1935).

Descriptors: *New York, *Ownership of beds, *Dams, *Non-navigable waters, Riparian rights, Industrial use, Damages, Remedies, Legal aspects, Judicial decisions, Relative rights, Condemnation, Right-of-way, Streamflow, Beds, Beds under water.

Plaintiff riparian landowner, whose predecessor had condemned a strip of his property running along a stream, sought an injunction to prevent defendant corporation from maintaining a dam across the stream. Plaintiff contended that the condemnation of the strip of land along the stream, when held by his predecessor, did not divest his predecessor of title to the streambed. Plaintiff thus contended that defendant had no right to maintain a dam across the stream. Defendant contended that it had acquired title to both the right-of-way and the streambed from its predecessor. The court held: (1) that the condemnation of the right-of-way did not deprive the riparian landowner of title to the bed; (2) plaintiff's predecessor had title to the bed because grants of land bounded by a stream convey the bed to the center of the stream; and (3) plaintiff was entitled to have the stream flow past his riparian property in its natural condition. Plaintiff could have the dam removed if he could show substantial damage. (Ouesada-Florida) W71-04776

BAILEY V UNITED STATES (LIABILITY OF UNITED STATES FOR PRESIDENT'S ULTRA VIRES CONDEMNATION OF OYSTER BEDS). 62 Ct Cl 77-96 (1926).

Descriptors: *Oysters, *Beds under water, *Condemnation, *United States, Leases, Federal government, Eminent domain, Compensation, Payment, Beds, Ownership of beds, Low water mark, Intertidal areas, Navigation, Judicial decisions, Legal aspects, Remedies.

Plaintiff lessee of oyster beds sued defendant United States for compensation for the taking of oyster beds. Plaintiff had leased oyster beds below low water mark from the state and had planted oysters. Pursuant to congressional legislation authorizing condemnation only to the low water mark, the President condemned plaintiff's lands for use as a naval base. Bulkheads were emplaced and the lands were filled. Defendant refused to compensate plaintiff. Since defendant's lease was below low water mark, the court concluded that the taking was ultra vires. Hence the court held that plaintiff possessed no rights within the authorized taking, nor without it, since an agent could not bind the United States to pay for an unauthorized taking. Plaintiff also contended that defendant's acts were not in exercise of navigational improvements, but the court observed that a naval base intrinsically involved navigational improvements. Accordingly, plaintiff was held unable to recover. (Hart-Florida) W71-04777

ALABAMA POWER CO V SMITH (POWER COMPANY'S LIABILITY FOR DAMAGE RESULTING FROM DAM OPERATIONS). 155 So 601-612 (Ala 1934).

Descriptors: *Alabama, *Dams, *Federal Power Act, *Discharge (Water), Electric powerplants, Bridges, Federal government, Legislation, Legal aspects, Judicial decisions, Adjudication procedure, Structures, Reasonable use, Navigable rivers, Reservoir operation, Reservoirs, Relative rights, Facilities, Damages, Backwater, Precipita-tion excess, Flow control, Water control, Water

Plaintiff was engaged in constructing a bridge in a river downstream from defendant power com-pany's dam. Without warning plaintiff, defendant released an unusual amount of water on one occasion to accomodate waters from a heavy rainfall. Plaintiff's construction was damaged severely by the water. Plaintiff sought damages, contending that: (1) defendant's agent orally agreed to notify plaintiff of any unusual occurrence, (2) defendant released the water with knowledge of the damage probable to plaintiff's construction, and (3) liability for such damage was imposed by the Federal Water Power Act. In reversing a judgment for plaintiff, the Supreme Court of Alabama held that the Water Power Act merely provided for a power licensee's assumption of liability otherwise existing. Negligence must still be shown. Power companies are not insurers for damage occurring downstream as a result of plant operations. There was no evidence of consideration supporting the purported agreement to notify plaintiff. Defendant's liability must rest on proof of negligence, a knowing release of water with probable damage to plaintiff. (Dye-Florida) W71-04779

THE OUTER CONTINENTAL SHELF-MANAGING (OR MISMANAGING) ITS RESOURCES, George Miron.

Journal of Maritime Law and Commerce, Vol 2, No 2, p 267-288, Jan 1971. 22 p, 58 ref.

Descriptors: *Continental Shelf, *Resource development, *Exploration, *Expolitation, Administrative agencies, Administration, Legislation, United States, Federal government, State govern-Environment, Environmental Leases, Permits, Public rights, Mineralogy, Oil, Oil industry, Oil waste, Marine geology, Oceans, Conservation, Evaluation, Geological survey, Treaties. Identifiers: *Outer Continental Shelf Lands Act, *National Environmental Policy Act.

It is contended that the United States at present is mismanaging the resources of the Outer Continen-tal Shelf. The Outer Continental Shelf Lands Act has extended United States jurisdiction to the Shelf for purposes of exploration and exploitation of resources and vests most of the responsibility for administering the Shelf in the Secretary of Interior. The author argues that there have been two principal failings in the administration of this Act. The first is an absence of environmental safeguards in the procedures for permitting exploration of the Outer Continental Shelf. The second is mismanage-ment of Shelf mineral exploitation. In the area of environmental protection the author finds that there is insufficient public participation in the permit procedure and a failure to obtain exploration data from permittees. As for mineral exploitation. the Department of Interior has followed an imprudent leasing strategy and permitted the control of output to be accomplished through state proration systems, which increases costs by setting quotas of production to wells regardless of their output potential. The author offers recommendations for improving the administration of Shelf resources. (Duss-Florida) W71-04781

RECENT DEVELOPMENTS IN THE LAW OF THE SEAS: A SYNOPSIS,

Michael B. Harris, and Anthony Lovett. San Diego Law Review, Vol 7, No 3, p 627-673, July 1970. 47 p, 68 ref.

Descriptors: *Oceans, *Legal aspects, *Water pollution, *Law of the sea, Judicial decisions, Legislation, Water resources development, International law, Admiralty, Administrative agencies, Administrative decisions, Water pollution effects, Water pollution control, Water pollution sources, Pollution abatement, United States, State governments, Oil, Wildlife, Zoning, Ships, Navigable waters, Navigation, Mineralogy, Fishing, Conservation.

This compilation of summaries of legal developments in the law of the seas between July 1, 1969, and March 15, 1970, covers the following areas: (1) conservation, both domestic and international; (1) conservation, both othersite and international, (2) fishing; (3) minerals; (4) navigable waters; (5) pollution, including domestic-inland, domestic-coastal, and international pollution; (6) salvage; (7) shipping; (8) sovereignty, including sections on jurisdiction and on the Northwest Passage; (9) water; (10) wildlife; and (11) zoning. The developments summarized include comments on enacted legislation, case law, meetings, conventions, executive proposals, and treaties. For example, the section discussing navigable waters includes a note on a federal district court decision regarding United States condemnation of a Maryland island and a comment on another federal district court decision regarding the contest of the Army Corps of Engineers' denial of an offshore dredge and fill permit in Florida. The section on domestic-coastal pollution comments on: (1) the Santa Barbara oil spill aftermath; (2) the ACLU suit to enjoin oil drilling in the Santa Barbara channel; (3) new leakage in the Santa Barbara channel; (4) a criminal action against oil companies involved in the Santa Barbara channel oil spill; and (5) proposed legislation banning oil drilling in the channel. (Hart-Florida) W71-04782

A LEGAL REGIME FOR DEEP SEA MINING, Ocean Resources Inc., La Jolla, Calif.

San Diego Law Review, Vol 7, No 3, p 488-503, July 1970. 16 p, 26 ref.

Descriptors: *International law, *Mineralogy, *Oceans, *Law of the sea, United Nations, Foreign countries, Governments, United States, Mineral in-dustry, Continental Shelf, Oceanography, International waters, Water pollution control, Exploration, Exploitation, Legal aspects, Water pollution.

Since the magnitude of the mineral resources of the sea is enormous, deep sea mining is a crucial factor in world development. However, only a few nations possess the technological capability to exploit deep sea minerals. Anomalously, these minerals have been termed the 'common heritage of mankind.' To ensure that this 'common heritage' inures to all people this article proposes a legal regime to control development of deep sea mining. The author notes that a legal regime is necessary to control pollution. Before outlining the proposed regime, the author describes the nature of deep sea deposits and their potential to world society. First, he discusses the jurisdiction of riparian nations in the oceans, established by the Geneva Convention. The spectrum of minerals available in seafloor nodules is examined in detail. A timetable for deep sea mining is proposed. A leasing agency, operated by the United Nations and having largely administrative functions, is suggested as the beginning of a legal regime to control deep sea mining. After establishment of the agency, the author proposes a code of laws allowing technically and financially competent nations to claim limited portions of the ocean floor. The laws would prevent interference with other ocean uses. (Hart-Florida) W71-04783

THE CONTROL OF POLLUTION BY OIL UNDER THE WATER QUALITY IMPROVE-MENT ACT OF 1970, Washington and Lee Univ., Lexington, Va. School

of Law.

For primary bibliographic entry see Field 05G. W71-04784

WILLIS V BOYD (VALIDITY OF MINING LEASE IN RIVER BED).

224 KY 732, 7 SW2d 216-218 (1928).

Descriptors: *Kentucky, *Navigable rivers, *River beds, *Leases, Ohio River, Banks, Islands, Ownership of beds, Legislation, Local governments, State governments, Legal aspects, Judicial decisions, Ex-cavation, Sands, Gravels, Mining, Steamboats, Boundaries (Property).

Plaintiff brought action to enjoin defendant from removing sand and gravel from the bed of the Ohio River. Plaintiff contended that he had an exclusive 50-year lease to remove sand and gravel from the river bed. Defendant contended that the statute authorizing the lease was invalid as in conflict with statutes limiting the acreage that the state and counties could patent to private parties. Moreover, defendant contended that the statute conflicted with the consitutional prohibition against legislation. The court noted that the limit on saleable acreage did not apply to leases of mining rights, that the statute could not affect any private property, and that the act was of general application although only affecting the Ohio River. However, the court reversed a lower court judgment for plaintiff, holding that the rights granted by the lease were profits a prendre and could only be granted at public auction and only for 20 years. (Liptak-Florida) W71-04785

THE SETTLEMENT OF DISPUTES BETWEEN FEDERAL AND STATE GOVERNMENTS CON-**PETROLEUM** CERNING **OFFSHORE** RESOURCES: ACCOMMODATION OR ADJU-DICATION,

John L. Taylor.

Harvard International Law Journal, Vol II, p 358-399, 1970. 42 p, 205 ref.

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Descriptors: *Beds, *Ownership of beds, *Continental Shelf, *Boundary disputes, Boundaries (Property), International waters, Interstate compacts, Oil, Federal government, State governments, Inland waterways, Judicial decisions, Legal aspects, Submerged Lands Act, Coasts, Gulf of Mexico, Great Lakes, Political aspects.

The increasing demand for petroleum has initiated an ongoing dispute between state and federal governments with regard to the ownership of offshore lands and the petroleum deposits therein. The author of this article assumes an international perspective in making a comparative examination of the ownership dispute in the United States, Canada, and Australia. A brief analysis is made of the problems and contrasting modes of dispute-settlement in each jurisdiction. The procedures examined are those of accommodation and adjudication. A constitutional and historical background is given in an effort to elucidate the practicality and efficacy of dispute-settlement procedures. author concludes with a jurisprudential discussion of dispute settlement and his suggestions for reaching a satisfactory result. The author recommends settlement of such disputes by the political arm of government. In the opinion of the author, judicial settlement should be resorted to only when political solutions fail. (Barnett-Florida) W71-04786

SURFACE WATER CONTROL IN NEW JERSEY, PART II: DRAINAGE, FLOOD CONTROL AND RELATED POLICIES IN AN URBAN STATE.

Rutgers-The State Univ., New Brunswick, N.J. Bureau of Government Research.

For primary bibliographic entry see Field 04A. W71-04787

NATIONAL ENVIRONMENTAL POLICY ACT OF 1969.

42 USCA secs 4321 thru 4335, 4341 thru 4347 (Supp 1970).

Descriptors: *Environment, *Administrative agencies, *Environmental effects, *Federal project policy, Legislation, Federal government, Ecology, Environmental gradient, Environmental sanitation, Administration, Adoption of practices, Decision making, Operations research, Project planning, Legal aspects, Leadership, Administrative decisions, Coordination, International waters. Identifiers: *National Environmental Policy Act.

This National Environmental Policy Act of 1969 establishes a Council on Environmental Quality and declares that the federal government will use all practicable measures to improve the national environment. Federal agencies are directed to cooperate with each other and with the Council on Environmental Quality. Every recommendation or report made by an agency must include: (1) the environmental impact of the proposed action, (2) unavoidable adverse environmental effects, (3) alternatives to the proposal, (4) the relationship between short-term use and long-term productivity, and (5) irretrievable resource commitments should the proposal be implemented. Agencies are required to recognize international environmental problems and support programs to prevent deterioration of the world environment. The President shall transmit an annual report on the state of the environment to congress and shall provide a pro-gram for remedy of environmental deficiencies. The Council on Environmental Quality is composed of three qualified members appointed by the President. It must: (1) assist the President in preparing his report to Congress, (2) monitor the national environment, (3) appraise federal programs in light of the environment, (4) conduct environmental research, (5) document environmental changes, (6) report to President annually on the environmental condition, and (7) make such other reports as the President requests. (Hart-Florida) W71-04788

ESTABLISHMENT OF THE OHIO RIVER BASIN COMMISSION.

Exec Order No 11578, Federal Register, Vol 36, No 11, p 683-684, Jan 16, 1971. 2 p.

Descriptors: *Water Resources Planning Act, *River basin development, *River basins, *Administrative agencies, River basin commissions, Land resources, Drainage, Ohio, State governments, Tennessee River, Federal government, Administration, Interstate compacts, Interstate commissions, Planning, Water resources development, Interstate.

Identifiers: *Executive orders.

Pursuant to the Water Resources Planning Act (79 Stat. 244, 42 U.S.C. 1962 et. seq.), which provides for the establishment of river basins, water and related land resources commissions, the President of the United States, Richard Nixon, established the Ohio River Basin Commission. This Commission shall have jurisdiction in those portions of the states of Kentucky, Illinois, Indiana, Maryland, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia that are located within the Ohio River drainage basin, excluding the Tennessee River drainage basin. The Commission shall consist of: (1) a chairman, appointed by the President; (2) one member from each of several federal departments and agencies; (3) one member from each of several selected states within the affected areas; and (4) one member from each interstate agency created by an interstate compact whose jurisdiction extends to the waters of the area specified. The duties of these members shall be executed in accordance with the provisions of the Water Resources Planning Act. (Barnett-Florida) W71-04789

DELAWARE RIVER BASIN COMMISSION CHARGES FOR WATER SUPPLY.

Delaware River Basin Commission, Trenton, N.J.

Federal Register, Vol 36, No 9, p 566-567 (Jan 14, 1971). 2 p.

Descriptors: *Administrative agencies, *Delaware River Basin Commission, *Water supply, *Water rates, Water users, Water demand, Water distribution (Applied), Federal government, Water costs, Water management (Applied), Water storage, Water quality, Contracts, Legal aspects, Administration, Costs, Operation and maintenance, Cities, Non-consumptive use, Pumping, Pumping plants, Administrative decisions, Diversion.

Notice is published herein that the Delaware River Basin Commission will hold a public hearing on Thursday, January 28, 1971, for discussion of a proposed resolution of policy to develop a rate basis for settling charges to users of water supplied by the Commission. Since: (1) revenues from the sale of water have been authorized as a means of repaying the non-federal share of the federal investment cost of water supply storage facilities, and (2) the Commission requires further policy to develop a fair and defensible rate basis for setting charges to users, the Commission has resolved to implement a five step plan for the imposition of water use charges. The proposed plan is reproduced in full. Those wishing to testify as to the plan are requested to register in advance. Also, public notice is established regarding the availability of a draft report (in accordance with the National Environmental Policy Act of 1969) discussing the environmental impact of a proposed pumping plant on the Delaware River at Point Pleasant, Pennsylvania. (Barnett-Florida)

DEBATE AND HOUSE PASSAGE OF THE WATER BANK ACT. 116 Cong Rec 9556-9561 (daily ed, Oct 5, 1970).

Descriptors: *Wetlands, *Wildlife habitats, *Legislation, *Water conservation, Flood protection, Flood control, Water resources, Water con-

tracts, Soil erosion, Wind erosion, Surface runoff, Surface waters, Drainage practices, Federal government, Federal project policy, Reservoirs, Land resources, Non-structural alternatives, Subsurface waters, Scenery, Land tenure, Real property, Waterflowl, Economic impact, Economics, Wildlife conservation. Identifiers: *Water Bank Act.

The text of the Water Bank Act (H.R. 15770), endorsements of the Act by leading conservationists, and a discussion of the Act on the House floor are contained in this portion of the Congressional Record. The objectives of the Act are described as: (1) preservation of surface waters, (2) preservation and improvement of habitats for migratory waterfowl and other wildlife; (3) reduction of flood ru-noff and soil erosion, and (4) flood control. These objectives are to be accomplished through government compensation to landowners who agree not to drain, burn, fill, or otherwise destroy wetlands to which they hold title. The view is expressed that the Act will present landowners with an economic alternative to the increasing drainage of wetlands. Dividends to be derived under the Act, in the view of one Congressman, include: (1) a recharging of underground water supplies, (2) the preservation of surface reservoirs, (3) increased flood protection, (4) protection of the ecological balance, and (5) preservation of natural beauty. Upon the conclusion of discussion, the Water Bank Act was passed, as amended, by a two-thirds vote of the House. (Earl-Florida)
W71-04791

FINANCIAL RESPONSIBILITY FOR OIL POL-LUTION CLEANUP (EXEMPTION OF NON-SELF PROPELLED BARGES FROM FINAN-CIAL RESPONSIBILITY REQUIREMENTS). Federal Maritime Commission, Washington, D.C.

Federal Register, Vol 36, p 834-835 (January 1971). 2 p.

Descriptors: *Water pollution control, *Oil, *Ships, *Rivers and Harbors Act, Insurance, Federal government, Water pollution, Water pollution sources, Legislation, Water law, Legal aspects, Risks, Compensation, Pollution abatement, Administration, Administrative agencies, Fuels. Identifiers: *Administrative regulations, *Federal Water Pollution Control Act.

The Federal Water Pollution Control Act requires every vessel over 300 gross tons to maintain evidence of financial responsibility to meet any liability to the United States resulting from the discharge of oil into United States waters. The River and Harbor Act of 1970 amended the Federal Water Pollution Control Act to exclude from the financial responsibility requirements of the Act 'any barge that is not self-propelled and that does not carry oil as cargo or fuel.' Pursuant to that amendment, the Federal Maritime Commission proposes to amend its regulation concerning maintaining and providing evidence of financial responsibility. New definitions are added, defining 'cargo' as including both proprietary and non-proprietary cargo, and 'fuel' as any oil capable of being burned for heat or power. (Liptak-Florida) W71-04792

CERTIFICATION OF FACILITIES (PROPOSED REGULATIONS FOR CERTIFYING POLLUTION CONTROL FACILITIES FOR TAX DEDUCTION PURPOSES).

Environmental Protection Agency, Washington, D.C.

Federal Register, Vol 35, p 19686-19688 (Dec 1970). 3 p.

Descriptors: *Pollution abatement, *Treatment facilities, *Administration, *Taxes, Water pollution, Water pollution control, Air pollution, Water pollution treatment, Public health, Wastes, Waste disposal, Waste treatment, Conservation, Adminis-

trative agencies, Regulation, Standards, State governments, Federal government, Government supports, Clean Air Act, Tax rate.

Identifiers: *Water Pollution Control Act, *Administrative regulations.

To insure consistency and uniformity in the implementation of section 704 of the Tax Reform Act, the functions of other agencies concerning certification of water pollution control facilities and air pollution control facilities were transferred to the Administrator of the Environmental Protection Agency. The Administrator proposed combined regulations regarding certification of air and water pollution control facilities for tax deduction purposes. All applications will be filed with the state certifying agency, which will forward the application and the state certification to the Administrator. The Administrator will not certify a facility prior to completion but may give notice of intent to certify provided the completed facility conforms to the applicable air or water quality standards. Applications shall contain specified data including a description of the proposed facility and its function, cost, and expected useful life. Federal policy is to cooperate with the states to enhance the quality and value of air and water resources. To be certified, a facility must: (1) control pollutants which would otherwise be released into the environment, (2) not be part of the manufacturing process, (3) meet all state and federal air or water quality standards, and (4) not recover its own cost through profits from recovered waste products or otherwise. (Liptak-Florida) W71-04793

EXECUTIVE ORDER 11574 (ADMINISTRATION OF REFUSE ACT PERMIT PROGRAM).

Federal Register, Vol 35, p 19627-19628 (December 1970). 2 p.

Descriptors: *Waste disposal, *Navigable waters, *Administration, *Permits, United States, Federal government, Administrative agencies, Regulation, Water pollution, Water pollution control, Abatement, Pollutants, Wastes, Effluents, Waste water (Pollution), Water quality, Water quality control, Legislation, Rivers and Harbors Act, Coordination,

Environment, Alteration of flow.

Identifiers: *Executive orders, National Environmental Policy Act.

In furtherance of the policies and purposes of the Federal Water Pollution Control Act, the Fish and Wildlife Coordination Act, and the National Environmental Policy Act, President Nixon ordered the executive branch to implement a permit program to regulate the discharge of pollutants and other refuse into the navigable waters of the United States. The Secretary of the Army is ordered, after consulting with the Administrator of the Environmental Protection Agency, to adopt regulations and procedures for processing permit applications. The Secretary has the responsibility for granting, denying, revoking, or suspending permits, but must accept the findings of the Administrator as to the effect on applicable water quality standards. A permit will be denied where state certification under the Federal Water Pollution Control Act is denied. If the proposed discharge impounds, diverts, deepens, or otherwise alters a water body, the Secretary is to consult the Secretary of the Interior, Secretary of Commerce, the Administrator, and the state wildlife resource agency regarding effects on fish and wildlife. The Secretary may make any appropriate consultations not specified if required by the National Environmental Policy Act, and the Attorney General shall conduct legal proceedings to enforce the permit program. Policies and procedures of the several agencies under the permit program will be coordinated by the Council of Environmental Quality. The Council will keep the President advised on the implementation of the program. (Liptak-Florida) W71-04794

YORK COVE CORP V UNITED STATES (LIA-BILITY FOR DREDGING OPERATIONS IN-CIDENT TO IMPROVEMENT OF NAVIGA-

317 F Supp 799-813 (Ed Va 1970).

Descriptors: *Federal government, *Navigable waters, *Dredging, *Navigation, Damages, Federal jurisdiction, Land tenure, Oysters, Leases, Commercial shellfish, Relative rights, Piers, Regulation, Beds, Real property, State jurisdiction, Navigable rivers, United States, Beds under water, Ownership of beds, Water pollution, Legal aspects, Judicial decisions, Remedies.

Plaintiff oyster-ground lessees sought compensation from defendant United States and its dredging contractor for damages to oyster beds. Plaintiff contended that defendant contractor, in repairing a naval pier, had negligently deposited spoil in a navigable channel near plaintiff's beds. Plaintiff held his lease under a state grant in an area previously ceded to the United States. Defendants asserted that dredging operations were incident to improvements in navigation and denied negligence. As to defendant United States, the United States district court held that: (1) the federal government may assert the doctrine of dominant navigational servitude as a defense to allegedly negligent dredging incident to the construction of a naval pier; (2) governmental supervision of allegedly negligent dredging does not invoke liability under the Federal Tort Claims Act, (3) a state is without jurisdiction to lease rights in underwater lands ceded to the United States, and (4) only the Secretary of the Navy is empowered to relinquish federal interests in submerged lands under naval jurisdiction. Determining that the United States had validly asserted the defense of navigational servitude, the court ruled that plaintiff had failed to prove defendant contractor's negligence, since the evidence was just as convincing that a severe storm had caused plaintiff's injury. (Earl-Florida) W71-04815

WILD AND SCENIC RIVERS ACT. 16 USCA secs 1271 thru 1287 (Supp 1969).

Descriptors: *Legislation, *Wild rivers, *Administration, *Conservation, Rivers, River systems, Recreation, Scenery, Water policy, Administrative agencies, Administrative decisions, Federal government, Federal project policy, Hydroelectric project licensing, Permits, State governments, Water pollution, Water pollution control, Eminent domain, Condemnation, Compensation.

In the Wild and Scenic Rivers Act, Congress declares that certain rivers shall be protected and preserved in their original condition. Rivers are categorized as: (1) wild, accessible only by trial; (2) scenic, accessible by trail generally, and by road over portions; and (3) recreationa, readily accessible by road or railroad. Eight rivers are named as components of the national wild and scenic rivers system, to be administered by either the Secretary of Agriculture or Interior. Either Secretary may propose additions to the system by making a report to the President and Congress. Reports must be coordinated with other affected agencies and published in the Federal Register. Twentyseven other rivers are designated as potential additions to the system; the Secretaries of Interior and Agriculture are directed to study each to determine the advisability of including it in the system. Limited power of condemnation is provided both secretaries to acquire land along the rivers. The Federal Power Commission is directed not to authorize construction of any power facility on a river which is a component of the system or any facility directly affecting a component river. Further, the Federal Power Commission is admonished not to authorize any project for five years on a river which is a potential component unless it is concluded that the river will not be included in the system. Cooperation with local government is solicited. (Hart-Florida) W71-04819

MONSANTO CO V EDWARDS TOWING CORP (DAMAGES TO DOCK FACILITY CAUSED BY BREAKAWAY OF MOORED BARGES). 318 F Supp 13-17 (ED Mo 1969).

Descriptors: *Docks, *Damages, *Ships, *Admiralty, Wharves, Rivers, Mississippi River, Missouri, Water levels, Judicial decisions, Legal aspects, Adjudication procedure, Navigable waters, Water level fluctuations, Fluctuation.

Plaintiff company brought suit against defendant towing company for damages to its dock facility. Four barges broke loose from a load fleet operated by defendant and struck plaintiff's dock. Defendant denied any negligence and filed a third-party complaint against another towing company which had tied two of the barges, alleging that the third party failed to adequately secure defendant's barges. The second towing company denied any negligence and filed a third-party complaint against a company whose vessel had passed the barges immediately prior to the breakaway, alleging that the vessel passed at an unreasonable speed and in close proximity to defendant's barges, causing the breakaway.
The federal district court found against the original defendant. The burden is upon a drifting vessel to show her freedom from negligence. Defendant, as a bailee, had the duty of caring for barges in its custody. A breakaway establishes a prima facie case of negligence against the operator of the moving ves-sel. Defendant was informed of a coming rise in the river which would require a change in mooring yet did nothing. No evidence indicated that the second towing company improperly moored the two barges or that the passing vessel generated a swell which would have caused the breakaway. (Duss-Florida) W71-04820

WATERFOWL AND MIGRATORY BIRDS (REGULATION AND LICENSING OF WATER-

(REGULATION AND LICENSING OF WATER-FOWL HUNTING).
Maryland Code Ann art 66 C, secs 150 thru 155, 157, 159, 161 thru 162 A, 164 thru 165 (Supp 1970).

Descriptors: *Maryland, *Legislation, *Hunting, *Waterfowl, Game birds, Migratory birds, Recreation, Small game, Wildlife, Wildlife conservation, Wildlife management, Regulation, Permits, Riparian land, Riparian water, State governments, Boats, Tidal waters, Fishing, Legal aspects.

The hunting of any wild water fowl shall be illegal in Maryland and except on dates set by federal regulation or the State Department of Game and Inland Fish. Hunting is prohibited on Sundays and may be hunted only with shotguns under ten gauge and long bows and arrows; all other weapons are prohibited. Sneak boats and body booting rigs may be licensed, and riparian owners have special licensing rights. Hunting by boat is forbidden. Shoreline distance requirements and application dates must be followed by riparian owners seeking to license blind sites. It shall be unlawful to set out grain to lure game birds; violators may be fined or imprisoned. Named counties are exempt from blind site distance requirements. The clerks of the circuit courts are to issue licenses and to collect the fees established herein upon proper application and certification for the specified dates. Blind sites shall be subject to inspections and licenses may be revoked for violations of the Act. Certain distances must be maintained between blind sites by property owners seeking to license sites in front of their property. Trespassing on another's blind and fishing within 500 yards of a blind are prohibited and licenses are required for operation of hired hunting boats. Penalties are provided for violators where specific penalties are not otherwise specified. (Liptak-Florida) W71-04822

UNITED STATES V 8,968.06 ACRES OF LAND (VALUATION OF RIPARIAN LAND IN EMINENT DOMAIN PROCEEDINGS). 318 F Supp 698-704 (SD Tex 1970).

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Descriptors: *Federal government, *Riparian land, *Eminent domain, *Condemnation value, Navigable rivers, Value, Property values, Appreciation, Depreciation, Land appraisal, Evaluation, Reservoirs, Riparian rights, Federal jurisdiction, Riparian waters, Condemantion, Real property, Land tenure, Legal aspects, Judicial decisions, Relative rights, Remedies.

In eminent domain proceedings condemning land for a reservoir project intended to improve naviga-tion, plaintiff United States sought to exclude evidence of land value arising from access to or utilization of navigable waters. Defendant riparian owner of agricultural land sought to establish the land's potential value as a channel-cut subdivision wherein all lots would have frontage on man-made channels. Defendant contended that depreciative consequences of the riparian location, such as the possibility of flooding, should be excluded in valuing the land. The United States district court held that under the doctrine of dominant navigational servitude a riparian owner of condemned land may not show potential land value arising from non-passive utilization of and access to navigable streams. However, value which is attritutable to mere passive proximity to navigable waters is compensable. Evidence of the depreciative consequences of the riparian location is admissible. The test for determining what potential land use may be shown is whether such use may be prohibited or destroyed by the United States without creating a constitutional duty to compensate. The court held riparian owners are not entitled to receive compensation or restrain injury incurred incident to navigational improvements. Plaintiff's motion was granted. (Earl-Florida) W71-04829

COASTAL WATERS AND THE NATION,

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of the

National Council on Marine Resources and Engineering Development, Washington, D.C. Edward Wenk, Jr.

Civil Engineering, Vol 39, No 6, p 52-55, June 1969.

Descriptors: *Water pollution control, *Federal government, *Coasts, *Resources. Identifiers: *Planning for multiple use.

Most of the nations population and industry are on the coasts. Recreation, maritime trade, fish and crustacean industry, offshore oil and gas industry are all coastal activities. The coastal area as a resource is diminishing rapidly due to marshland filling, waste disposal, oil seepage and tanker accidents. Planning which rationally weighs the demands for development against esthetic and natural resources is needed. The federal government is undertaking studies and considering state managed Coastal Zone Authorities for planning and regulating land and water use. The states have legal jurisdiction over most coastal resources but need better coordinated and stronger agencies. (Ensign-PAI)

AN ACT RELATING TO WATER POLLUTION CONTROL.

Laws of Vermont, No 252, Public Acts, 1969 Adjourned Session, p 252-264 (1970). 13 p.

Descriptors: *Vermont, *Legislation, *Administrative agencies, *Water pollution control, Water pollution, Water pollution sources, Water pollution effects, Water resources, Pollutants, Pollution abatement, Permits, State governments, Legal aspects.

This legislation categorizes all Vermont waters into two classes. Class A waters are: (1) waters of lakes, ponds, or reservoirs used for public water supply and (2) water flowing into these waters. Class B waters are all other waters. The following factors are used to classify degree of water quality to be required of water classes: (1) existing water quality; (2) existing or potential water uses; (3) natural

sources of pollution; (4) public and private pollution sources; (5) need for mixing zones; (6) existing and potential use of waters for public water supply, recreational, agricultural and other uses; (7) suitability of waters as habitats for fish and wildlife; (8) need for minimum stream flow; (9) federal requirements for classification and management; (10) municipal, regional, and state plan; and (11) any other relevant factors. The act prohibits discharge of any material into state waters without a permit. Temporary permits may be issued. A permit allowing the discharge of material into waters of the state will be denied where the discharge would reduce the quality of the water below the level established for its classification. (Hart-Florida)

WATERS AND WATER SUPPLY--SEWERS--USES.

New Jersey Session Law Service, Chapter 91 (1970), amending New Jersey Revised Stat, Sec 58:12-3 and Supplementing New Jersey Revised Stat, Tit 58, Ch 12.

Descriptors: *New Jersey, *Legislation, *Water pollution, *Sewers, Remedies, Administrative agencies, Pollution abatement, Pollutants, Water pollution control, State governments, Non-structural alternatives, Legal aspects, Sewage disposal, Cities, Drainage, Drainage systems, Wastes.

This amended statute prohibits any person, corporation, or municipality from building or using a sewer or drainage system which discharges pollutants into state waters without approval by the state Department of Health. Violation of the law sujects the offender to a fine of at least \$1000 and not more than \$3000. If the violation is continuous, each day will constitute a separate violation. (Hart-Florida) W71-04833

ENVIRONMENTAL QUALITY IMPROVEMENT.

42 USCA secs 4371 thru 4374 (Supp 1970).

Descriptors: *Legislation, *Environment, *Federal government, *Administrative agencies, Ecology, Conservation, Contracts, Legal aspects, Water policy, Administration, United States, Natural resources, Natural resources development.

The Environmental Quality Improvement Act of 1970 was enacted to implement the national policy of enhancing the environment. The legislation has two purposes: (1) to assure implementation of the national environmental policy by federal agencies; and (2) to authorize an Office of Environmental Quality. The Chairman of the Council on Environmental Quality is designated director of the Office. A deputy director is appointed by the President. The duties of the director are: (1) to provide the staff and support for the Council on Environmental Qualtiy; (2) to assist federal agencies in appraising the effectiveness of federal projects affecting environmental policy; (3) to review the adequacy of existing systems for monitoring and predicting environmental changes; (4) to promote advancement of scientific knowledge of the environment; (5) to assist in coordinating environmental activities of develop environmental quality standards; and (7) to collect and analyze information on environmental quality. The director is authorized to contract with public or private agencies in performing his duties. Environmental quality reports are to be referred to a standing congressional committee. Appropriations for the office through 1973 are established. (Hart-Florida) W71-04834

TRUMBULL V MCINTOSH (FILLED LAND SUBJECT TO PRIOR MORTGAGE OF UPLAND), 138 So 34-36 (Fla 1931).

Descriptors: *Florida, *Riparian rights, *Riparian land, *Relative rights, Beds, Legislation, Shores, High water mark, Low water mark, Navigable waters, Channels, Landfills, Tidal waters, Legal aspects, Judicial decisions.

Plaintiff mortgagee sought to enforce a mortgage lien against riparian land, including submerged land filled in by mortgagor's grantee. Defendant was a judgment creditor of mortgagor's grantee and contended that the filled in land was not subject to the mortgage because it was filled in after the mortgagor's conveyance. The trial court subjected the entire land to the mortgage lien and the Supreme Court of Florida affirmed. The State Riparian Act, which describes the rights of riparian owners, was passed before execution of the mortgage, and was in effect at execution. One of the rights granted by the Act is the right to fill in submerged land. The statutory rights were vested in the mortgagor and thus were included in the mortgage lien. Rights in the filled-in land were acquired subject to the lien, and the fact that the grantee filled in the land subsequently did not give the grantee statutory rights against the mortgage lien. The source of title to submerged land is the statutory right vested in the riparian owner and is obtained by the process of filling in. (Duss-Florida)

WATERS AND WATER SUPPLY--POLLUTION--PENALTY.

New Jersey Session Law Service, Chapter 90 (1970), amending, NJ Revised Stat secs 58:10-1, 58:10-2, 58:10-4.

Descriptors: *New Jersey, *Water pollution, *Remedies, *Legislation, Administrative agencies, Pollution abatement, Pollutants, Water pollution control, State governments, Non-structural alternatives, Legal aspects, Cities.

This amended statute provides that whoever pollutes state waters shall be fined \$1000 for the first day and \$3000 for each day thereafter. Each day's continuance is a separate offense. The local board of health in the jurisdiction where the offense occurs is empowered to sue for payment of penalties imposed by this section. The Department of Health is authorized to settle with the offender. The fines recovered are to be paid either into the State Treasury or into a municipal treasury, depending upon the identity of the plaintiff in the action. In addition, the statute provides that a summary injunction may be issued to restrain pollution. Either the Department of Health or a local health board may seek the injunction. (Hart-Florida)

AN ACT TO CREATE AN ENVIRONMENTAL BOARD AND DISTRICT ENVIRONMENTAL COMMISSIONS.

Laws of Vermont, No 250, Public Acts, 1969 Adjourned Session, p 237-250 (1970). 14 p.

Descriptors: *Vermont, *Legislation, *Administrative agencies, *Environment, Land management, Land development, Land classification, Land use, Land resources, Water resources, Natural resources, Scenery, Aesthetics, State governments, Legal aspects, Administration, Permits, Administrative decisions.

This legislation creates a state environmental board and nine district environmental commissions. The board and district commissions are to consider applications for permits to develop and subdivide land. Before granting permits, the commissions must consider whether subdivisions: (1) will result in undue air or water pollution; (2) have sufficient water available; (3) will unreasonably burden existing water supplies; (4) will cause unreasonable soil erosion or reduce the capacity of the land to hold water; (5) will cause highway congestion (6) will unreasonably burden local educational facilities; (7) will unreasonably burden local governmental sources; or (8) will have an unduly adverse effect upon the scenic and natural beauty of the area in

Water Law and Institutions-Group 6E

which proposed. A development must also conform to a development plan and a land use plan promulgated by the board. The purpose of the development plan is to achieve a coordinated, efficient, and economic development of the state. The land use plan is based upon the development plan and consists of a map and statements of present and prospective land uses. These plans must be approved by the governor. (Hart-Florida) W71-04839

CALIFORNIA DEPT OF FISH AND GAME V S S BOURNEMOUTH (SHIP'S LIABILITY FOR DAMAGES RESULTING FROM OIL SPILL). 318 F Supp 839-842 (CD Cal 1970).

Descriptors: *California, *Oil wastes, *Ships, *Water pollution sources, Water pollution, Admiralty, Harbors, Navigable waters, Damages, Winds, Wind tides, Tides, Chemical analysis, Legal aspects, Judicial decisions, Oil industry.

Plaintiff state of California sought damages from defendant vessel for damages resulting from an oil spill in a harbor. Defendant denied that it was the source of the spill and contended that, even if it were the source of the pollution, there was no evidence of any intentional or negligent acts or omissions of the defendant's crew which might have caused the spill. The federal district court rendered judgment for the plaintiff. Evidence of the location of the spill in relation to the location of the ship and chemical analysis of oil from the spill supported a finding that defendant was the source of the oil spill. Secondly, the facts of the case presented an appropriate situation for application of res ipsa loquitur. Oil spills of this type would not ordinarily occur without negligence, and the evidence eliminated any other cause which might have been responsible for the spill. (Duss-Florida) W71-04840

ENVIRONMENTAL SERVICE (CREATION OF STATE AGENCY FOR WASTE TREATMENT CONTROL).

Maryland Code Ann art 33B, secs 1 thru 32 (Supp 1970).

Descriptors: *Maryland, *Legislation, *Waste disposal, *Administrative agencies, Sewage disposal, Waste water disposal, Waste treatment, Solid wastes, Waste water (Pollution), Environmental sanitation, Sewage treatment, Waste water treatment, Water districts, Water purification, Public health, Water pollution treatment, Water quality control, Cities, Governments, State governments, Government finance, Government supports, Planning, Legal aspects.

To provide for more effective purification and disposal of liquid and solid wastes, the Maryland Environmental Service is created and provisions made for personnel and expenses. The Environmental Service shall be responsible for planning, research, development, and construction of waste water purification and solid waste disposal projects in cooperation with the affected municipalities. The Service may: (1) contract, (2) sue and be sued, (3) acquire property, (4) exercise eminent domain powers, and (5) borrow money and issue bonds to carry out its functions. The Service's prime responsibility is to create waste water purification and waste disposal regions and districts and, after public hearing, to adopt five-year plans for the pro-jects needed in each region. Upon the failure of a person or a municipality to carry out an order of the Secretary of Health or the Secretary of Natural Resources, the Service may carry out those orders and charge the non-complying party for its expense in so doing. The Service is authorized to issue revenue bonds and fix rates and fees to provide a bond retirement fund. The Public Service Commission will arbitrate any rate disputes and judicial review shall be available, including the right of appeal to the Maryland Court of Appeals. (Liptak-Florida) W71-04841

WETLANDS (REGULATION OF DREDGE AND FILL OPERATIONS ON STATE AND PRIVATE WETLANDS).

Md Code Ann, Art 66c, Secs 718 thru 731 (Supp 1970).

Descriptors: *Maryland, *Wetlands, *Dredging, *Landfills, Conversation, State governments, Tidal waters, Excavation, Land forming, Land development, Water conservation, Permits, Natural resources, Riparian rights, Riparian land, Water resources, Coasts, Environmental effects, Regulation, Administrative agencies, Administrative decisions, Legal aspects, Adjudication procedure, Legislation.

Whereas dredging, dumping, and filling are despoiling Maryland's wetlands and diminishing their value as wildlife habitats and recreation centers, it shall be public policy to protect and preserve the state's wetlands. Riparian owners shall be guaranteed the right to natural accretion and to make improvements, consistent with this policy, to preserve access to the water. All dredging and filling on the state's wetlands is unlawful unless licensed by the Board of Public Works. When considering a license application, the Board shall take into account the ecological, economic, developmental, recreational, and aesthetic factors of each project. Anyone violating the Act may be fined and shall pay the State for the restoration of the wet-lands affected. The Secretary of Natural Resources shall make an inventory and a map of all private wetlands within the state and adopt rules and regulations governing dredging and filling of private wetlands. Affected landowners are entitled to a hearing and to a review of the inventory or the rules and regulations. Persons wishing to conduct activities not authorized by the rules and regulations may apply for a permit under defined application, notice, and hearing procedures. The Secretary shall consider the impact of the proposed work under the stated public policy. Parties are entitled to a jury trial de novo, not subject to the state adminisprisoned. Riparian rights are unaffected except as specifically provided. (Liptak-Florida) W71-04842 trative procedure act. Violators may be fined or im-

PUBLIC WATER SUPPLY AND SEWER SYSTEM (FINANCIAL SUPPORT FOR MUNICIPAL SEWAGE TREATMENT WORKS). Tennessee Code Ann secs 53-2017 thru 53-2028 (Supp 1970).

Descriptors: *Tennessee, *Legislation, *Sewage treatment, *Government supports, Treatment facilities, Public utilities, Sewage, Pumping plants, Sewage disposal, Municipal wastes, Industrial wastes, Domestic wastes, Sewers, Water Quality Act, Water pollution treatment, Governments, Local governments, State governments, Government finance, Water law, Taxes, Financing, Cost repayment, Water works, Water rates, Cities.

After defining sewage treatment works, construction, department, eligible project, municipality, and federal pollution abatement assistance, this chapter of the Tennessee Code authorizes the State of Tennessee to grant funds to assist municipalities in the construction of sewage treatment works. The public health department is designated to administer the grants and may contract with mu-nicipalities subject to specified financial provisions. A sewage treatment works construction fund is created in the state treasury and may be maintained by appropriations and bond sales. Municipalities receiving aid shall establish and collect a sewer users fee according to the listed schedule of residential and commercial-industrial users service charges. Cities may make sewer use mandatory, shall have enforcement powers, and may bring ac tions to collect delinquent charges. Municipalities may levy and collect additional fees or tolls for maintenance and operation or debt payments.
Users fees shall be remitted to the state funding board for retirement of bond issues and any excess shall be returned to the municipalities. Deficiencies shall be paid out of increased user rates or ad

valorem taxes, and the state may withhold funds from any muncipality failing to remit fees. (Liptak-Florida) W71-04843

AALSBURG V CASHION (RELATIVE RIGHTS TO ACCRETED LAND ON NAVIGABLE LAKE SHORE). 180 NW2d 792-798 (Mich 1970).

Descriptors: *Michigan, *Accretion (Legal aspects), *Boundary disputes, *Real property, Relative rights, Lakes, Lake shores, Land tenure, Navigable waters, Riparian land, Bank erosion, Boundaries (Property), Riparian rights, Judicial decisions, Legal aspects.

Plaintiff riparian owners sought determination of riparian boundaries involving accreted land as against defendant adjoining riparian owners. The common grantor, after conveying all lots in question without riparian rights, executed a riparian deed creating riparian rights in all conveyed lots. Such deed also provided that a strip of shoreline along the navigable inland lake was subject to the use of all lot owners. Plaintiff asserted that defendant acquiesced, used, and consented to extension of their side lot lines in setting common boundaries over accreted lands. The Supreme Court of Michigan held that: (1) neither acquiescence nor hostile possession is made out by joint use of riparian property, nor by mutual reliance on terms of common riparian deed; and (2) a county survey will be given greater weight than a witness' testimony in determining the intent of the grantor of a common riparian deed. That part of the decision of the lower court finding neither acquiescence nor hostile possession was affirmed, and the case remanded for determination of the remaining issues. (Earl-Florida) W71-04844

HOGUE V STRICKER LAND AND TIMBER CO (ALTERATION OF STATE BOUNDARY BY CHANGE IN CHANNEL OF MISSISSIPPI RIVER). 69 F2d 167-169 (5th Cir 1934).

Descriptors: *Louisiana, *Mississippi, *Mississippi River, *Boundary disputes, Boundaries (Property), Land tenure, Real property, Riparian land, Islands, Accretions (Legal aspects), Avulsion, Bank erosion, Erosion, Channels, State jurisdiction, Channel erosion, Channel flow, Rivers, Navigable rivers, Thalweg, Adjudication procedure, Legal aspects, Judicial decisions.

Plaintiff riparian landowner brought action against defendant land company to quiet title to accreted land. The question on appeal was the identity of the state in which the land was situated. The disputed land had accreted to an island in the Mississippi River. The river channel was originally east of the island, and hence the island was originally in Louisiana rather than Mississippi. That channel dried up and a new channel formed west of the island. Plaintiff claimed the land which had accreted between the two channels as accretions to his uplands on the Mississippi side. The Fifth Circuit Court of Appeals determined that when a stream's course between states changes by erosion and accretion, the boundary moves with the channel, but where the course changes by avulsion, suddenly leaving the old channel, the boundary is unaltered. Where, as in the instant case, the drying up of a channel results from the diversion of water into a new channel, rather than from accretion, the change must be likened to avulsion. In such a case state boundaries are unchanged. The court held that the disputed land was in Louisiana and that the Mississippi court was without jurisdiction. (Hart-Florida) W71-04845

Group 6E—Water Law and Institutions

PRESERVATION OF FISHERY RESOURCES (AUTHORIZATION OF FEDERAL-STATE AGREEMENTS AND COST SHARING).
16 USCA secs 757 A (a), 757 A (c), 757 D (a) (Supp 1970) amending 16 USCA secs 757 A, 757 D (1964).

Descriptors: *Federal government, *State governments, *Anadromous fish, *Fish conservation, Legislation, Fisheries, Fish management, Fish populations, Environmental effects, Federal project policy, Cost allocation, Cost sharing, Project planning, Project purposes, Administrative agencies, Administrative decisions, Administration, Water resources development, Non-structural alternatives, Legal aspects, Conservation, Coordination, Contracts, Benefits, Fish.

The Secretary of the Interior is authorized by this legislation to enter into cooperative agreements with states or other non-federal interests to conserve, develop and enhance anadromous fishery resources which are being depleted by water resources developments. Any such agreement must prescribe: (1) actions to be taken by the parties; (2) expected benefits; (3) estimated costs; (4) the share of the costs to be borne by the respective parties; (5) duration; (6) means of disposing of property acquired during the agreement; and (7) other conditions the Secretary desires. The federal share of costs shall not be more than 50%, and the non-federal share may be in form of realty or personalty. When two states enter into the agreement with the Secretary, the federal share is increased to 60%. Appropriations through fiscal 1974 are established. (Hart-Florida) W71-04846

ANDERSON V CITY OF LUDLOW (CITY'S LIA BILITY FOR STORM-SEWER OVERFLOW FOLLOWING STREET IMPROVEMENTS). 250 Ky 204, 62 SW2d 785-788 (Ky 1933).

Descriptors: *Kentucky, *Storm drains, *Paving, *Flood damage, Cities, Drainage systems, Sewers, Floodwater, Soil surfaces, Overflow, Surface runoff, Damages, Surface drainage, Flow rates, Real property, Land tenure, Local governments, Legal aspects, Judicial decisions, Flow, Road construc-tion, Excess water (Soils), Rainfall-runoff relationships.

Plaintiff residential lot owner sought to recover damages from defendant city for flooding resulting from storm sewer overflow. Plaintiff's property was flooded after defendant city paved and constructed catchbasins for nearby streets. The sewer line in question was constructed prior to the incorporation of plaintiff's property into defendant's municipal boundaries. Plaintiff contended that defendant's improvements created the overflow by diverting additional water into the formerly adequate sewer system. Defendant denied that its actions diverted surface water into the sewer lines at issue. The Court of Appeals of Kentucky held that a municipal corporation is not liable for flooding damages where street improvements merely accelerate but do not increase the volume of water flowing into a sewer line in existence prior to incorporation of territory into a city. The court denied plaintiff relief, ruling that defendant's street improvements had only accelerated the flow of water which previously was partially absorbed by trees and soil. (Earl-Florida) W71-04847

6F. Nonstructural Alternatives

FLOOD PLAIN INFORMATION OF LOWER SOUTH RIVER, METROPOLITAN ATLANTA. GEORGIA.

Corps of Engineers, Savannah, Ga. For primary bibliographic entry see Field 04A. W71-04849

6G. Ecologic Impact of Water Development

ENVIRONMENTAL FOR GEOLOGY MONROE COUNTY, PLANNING MICHIGAN, Wayne State Univ., Detroit, Mich. Dept. of Geolo-

For primary bibliographic entry see Field 04C. W71-04370

A METHODOLOGY STUDY TO DEVELOP EVALUATION CRITERIA FOR WILD AND SCENIC RIVERS.

Idaho Univ., Moscow. Water Resources Research For primary bibliographic entry see Field 06B.

W71-04420

TECHNOLOGICAL INJURY, Blackburn Coll. of Technology and Design (England). J. Rose

New York, Gordon and Breach, 1969. 224 p.

Descriptors: *Technology, *Pollution, *Environment, Air pollution, Water pollution, Pesticides, Computers, Transportation, Government, Radioactive wastes. Social aspects,

Identifiers: *Technological change, Noise, Level,

This book is a collection of fifteen papers concerned with the effect of technology on environment, life and society. It attempts to present an account of the potential and actual dangers of technological advances by outlining the main areas of conflict and danger. It is of interest to the water researcher not only due to its explicit consideration of water pollution but also because of the insights it provides into water resources problems through the treatment of related environmental areas. The first section is concerned with pollution of the environment and considers the problems of air and water pollution, radioactivity, pesticides, drugs and pollution of outer space. The second section considers the effects on society and life of drugs, genetics, computers, transportation, noise, and leisure and concludes with a general discussion of the effect of technological change. (See also W71-04466) (Murphy-Rutgers) W71-04465

MAN AND AQUATIC COMMUNITIES.

Spring 1970 seminar. Oregon State University, Corvallis, Water Resources Research Institute SEMN WR 012.70, 1970. 106 p, 11 fig, 2 tab, 71 ref. OWRR Project A-999-ORE (6).

Descriptors: *Ecology, *Aquatic environment, *Eutrophication, *Lakes, *Oregon, Industries, Marine animals, Fresh water, Radiation, Aquiculture, Fish, Ponds, Ecosystems, Monitoring, Management, Adhesives, Dye releases, Oysters, Bioassay, Salinity, Bacteria, Algae, Insects, Copepods, Detritus, Rhodophyta, Chlorophyta, Cyanophyta, Protozoa, Mollusks, Fungi, Ferns, Gymnosperms, Radioisotopes, Mussles, Snails. Identifiers: *Rocky shores, *Cultural impact, *Luke Lake evolution, Chironomids, Ostracods,

Applied and more fundamental studies relating to metabolism and physiological requirements of algae and other aquatics, and to development of assay procedures for detecting increased enrichment and its effects are discussed. Rocky shores are described with plans for educational field trips. The Weyerhaeuser Company, supporting operations and products other than lumber, has research teams studying aquatic problems. Oyster investigations, experimental stream studies, liquid waste monitoring, and waste treatment facility performance are described. A historical review of algae is presented. Documentation of algae in human economy (exploitation of marine colloids, algal toxins), for utilization in human objectives (closed-system ecology--waste disposal), or for their contribution to animal production important in various human activities. Radioactive isotopes can provide information of movement of a single element from one organism to another or one tissue to another and help unsort complexities of aquatic foodwebs. Radionuclide cycling makes possible increased precision of measurement. Four lakes were used to assess productivity and evolution due to cultural impact. Aquiculture industrial development at coastal steam-electric stations is underway. Effect on marine biota of fluctuations in oceanic currents, temperature, and salinity, are studied. Public and private fish habitats are described. (Jones-Wisconsin) W71-04629

EFFECT OF COOLING TOWER EFFLUENTS ON ATMOSPHERIC CONDITIONS IN NORTHEASTERN ILLINOIS, PRELIMINARY REPORT.

Illinois State Water Survey, Urbana. F. A. Huff, R. C. Beebe, D. M. A. Jones, G. M. Morgan, Jr., and R. G. Semonin.

Available from State of Illinois, Dept. of Registration and Education. Illinois State Water Survey, Circular 100, 1971. 37 p, 1 fig, 2 tab, 57 ref.

Descriptors: *Cooling water, *Cooling towers, *Water cooling, *Nuclear powerplants, *Water pollution sources, *Air environment, *Meteoric water, Thermal pollution, Fog, Cloud physics, Air pollution, Air-water interfaces, Microenvironment, Micro-climatology, Weather modification, Rain-fall, Snowfall, Computer models, Industrial water. Identifiers: *Cooling tower effluents.

Controversy presently exists over the use of Lake Michigan and other natural water bodies for the discharge of waste heat from large electric power plants. This problem has become especially acute in the case of a 2200-megawatt nuclear power plant of the Commonwealth Edison Company now nearing completion at Zion, located on Lake Michigan in the northeastern part of Illinois. This plant was designed for once-through-cooling utilizing lake discharge of the waste heat, but this method of cooling has met opposition. An alternative method of solving the thermal pollution problem is through the use of large cooling towers. However, this alternative then raises concern about the environmental consequences of the effluent discharge into the atmosphere from the towers. Numerical modeling provided quantitative estimates of how high a plume cloud ejected from the 250-foot Zion towers would rise. It was found that the top of the moist plume could vary between 1800 and 5500 feet. Other results indicated that the enhancement of warm season rainfall by Zion tower plumes would probably be negligible but an average annual increase of 1 to 2 inches of snowfall could be expected within a distance of 2 miles inland from the power plant. Analyses indicated that the typical onshore lake breeze in spring and early summer would not normally trap the tower plume cloud near the ground to enhance inland fogging. The lake breeze interaction with the tower effluent is not expected to increase significantly convective cloudiness and rainfall in the Zion area. (Poertner) W71-04682

THE ECONOMICS OF CLEAN WATER: INOR-GANIC CHEMICALS INDUSTRY PROFILE. Federal Water Pollution Control Administration, Washington, D.C.

For primary bibliographic entry see Field 05B. W71-04686

ECOLOGICAL MODELING RESEARCH IN THE GREAT LAKES,

Michigan Univ., Ann Arbor. Dept. of Wildlife and Fisheries; and Michigan Univ., Ann Arbor. Dept. of Civil Engineering.

Data Acquisition—Group 7B

For primary bibliographic entry see Field 06A. W71-04780

NATIONAL ENVIRONMENTAL POLICY ACT

For primary bibliographic entry see Field 06E. W71-04788

WETLANDS (REGULATION OF DREDGE AND FILL OPERATIONS ON STATE AND PRIVATE WETLANDS).

For primary bibliographic entry see Field 06E. W71-04842

07. RESOURCES DATA

7A. Network Design

MEAN DISCHARGE AS AN INDEX TO MEAN MAXIMUM DISCHARGE.

EIE Dept., Ankara (Turkey).

For primary bibliographic entry see Field 02E. W71-04394

7B. Data Acquisition

AREAL MEASUREMENTS OF WATER EQUIVALENT OF SNOW DEPOSITS BY MEANS OF NATURAL RADIOACTIVITY IN THE GROUND.

Institutt for Atomenergi, Kjeller (Norway); and Norwegian Water Resources and Electricity Board,

For primary bibliographic entry see Field 02C. W71-04374

RADIOACTIVE TRACING IN FROZEN RIVERS.

Ceskoslovenska Akademie Ved, Prague. Inst. of Hydrodynamics; Ceskoslovenska Akademie Ved, Prague. Ustav Jaderneho Vyskumn; Hydrometeorologicky Ustav, Ostrava zechoslovakia)

For primary bibliographic entry see Field 02C. W71-04382

APPLICATION OF THE THEORY OF GRAPHS INVESTIGATION OF COMMUNITIES OF AQUATIC ORGANISMS, (IN RUSSIAN), Akademiya Nauk SSSR, Leningrad.

Institut Evolyutsionnoi Fiziologii i Biokhimii.

. Menshutkin.

English summary. Zhurnal Obschchei Biologii, Vol 30, No 1, p 42-49, 1969. 5 fig, 10 ref.

Descriptors: *Data collections, *Measurement, *Aquatic populations, Analysis, Biomass, Primary productivity, Energy, Predation.
Identifiers: *Graph theory, Trophic net, Linear

relationships.

The theory of graphs promises a reduction in the use of highly complex system of differential equations requiring electronic computations. The structure of heterotrophic communities of aquatic organisms are featured in terms of graphs and related simple equations comprising the trophic net and the energy balance of populations. The method provides a possibility of estimating the ratio of the biomass and primary production. Examples of communities made up of three and four popula-tions illustrate conditions when suppression of predators is either harmful or beneficial. The graphic approach has definite advantages because of its simplicity, but its application is limited to stationary entities and linear trophic net relationships. (Wilde-Wisconsin) W71-04522

RADIOACTIVITY IN CALIFORNIA WATERS JULY-DECEMBER 1968.

California State Dept. of Public Health, Berkeley. Bureau of Radiological Health.

For primary bibliographic entry see Field 05B. W71-04530

ESTIMATING SUSPENDED SEDIMENT CON-CENTRATIONS IN STREAMS BY TURBIDITY MEASUREMENTS,

Agricultural Research Service, Danville, Vt.; and Agricultural Research Service, Beltsville, Md. Hydrograph Lab. Samuel H. Kunkle, and George H. Comer.

Journal of Soil and Water Conservation, Vol 26, No 1, p 18-20, January-February 1971. 3 p, 3 fig,

Descriptors: *Suspended load, *Turbidity, Stream erosion, Scour, Sediment transport, Vermont, Sampling, Estimating, Erosion, Discharge (Water),

Topography, Soil properties, Snowmelt. Identifiers: *Sleepers River Experimental Watershed (Vt).

Turbidity and suspended sediment analyses were made on stream samples collected in the Sleepers River watershed of northeastern Vermont. Results showed that turbidimeter readings could be used to estimate suspended sediment concentrations in the 16- to 6,366-milligrams-per-liter range. The prediction equation was similar for the three watersheds studied, where soils, topography, and other factors were essentially the same. Samples were collected during two years of storm and snowmelt runoff on catchments draining from 16.2 to 43.5 square kilometers. Discharges reanged from 140 to 18,000 liters per second. The sediment particles were mostly of stream bank origin and were primarily silt or very fine sand. (Knapp-USGS) W71-04560

DEEP-SEA IN SITU CALCIUM CARBONATE

SATUROMETRY, California Univ., Los Angeles. Dept. of Geology; and California Univ., Los Angeles. Geophysics and Planetary Physics.

S. Ben-Yaakov, and I. R. Kaplan.

Journal of Geophysical Research, Vol 76, No 3, p 722-731, January 20, 1971. 10 p, 4 fig, 4 tab, 21 ref. USAEC Contract AT (04-3)-34 PA 178.

Descriptors: *Calcium carbonate, *Aqueous solu-*Sea water, *Water chemistry, *On-site Sampling, Chemical precipitation, Saturation, Equilibrium, Instrumentation, Pacific Ocean, Chemical potential, Oxidation-reduction potential, Hydrogen ion concentration. Identifiers: *Saturometers.

An in situ oceanographic system was used to measure the degree of saturation of calcium carbonate in sea water. Results of two profiles measured in the eastern Pacific Ocean off southern California are described and compared with data obtained by conventional chemical techniques. From this preliminary study it appears that the waters investigated become undersaturated with calcite at a depth of approximately 400 meters and remain so to a depth of about 1600 meters, where they tend toward saturation. Below 2500 meters they appear to become undersaturated again and probably remain so to the depth of the ocean floor. (Knapp-W71-04568

HYDROGEOPHYSICAL SURVEY USING REMOTE-SENSING METHODS FI KAWAIHAE TO KAILUA-KONA, HAWAII, **FROM** Hawaii Univ., Honolulu. Dept. of Geology; and

Michigan Univ., Ann Arbor. William M. Adams, Frank L. Peterson, Surendra P.

Mathur, Larry K. Lepley, and Clifton Warren. Groundwater, Vol 9, No 1, p 42-50, January-February 1971. 9 p, 10 fig, 18 ref. OWRR Project B-015-HI (2).

Descriptors: *Remote sensing, *Geophysics, *Hydrogeology, *Hawaii, Infrared radiation, Electrical studies, Magnetic studies, Resistivity, Surveys, Groundwater movement, Discharge (Water). Identifiers: Hawaii County (Hawaii).

Application of remote sensing techniques to the water resources of the Kona Coast of the island of Hawaii in Hawaii include aerial infrared scanning and low-level aeromagnetic surveys as major reconnaissance methods. For detailed study, modified audiomagnetotelluric and D. C. resistivity profiling methods were used. The improved knowledge of subsurface structure confirmed the expectation that no large flows, such as suitable for commercial exploration, occur in that coastal sector. (Knapp-USGS)
W71-04582

FLOW MEASUREMENTS IN THE DANUBE.

Vienna Univ. (Austria). Institut fuer Radium-forschung und Kernphysik; and Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H..

For primary bibliographic entry see Field 02E. W71-04591

NUCLEAR TECHNIQUES IN STUDIES OF DISPERSION AND SOME OTHER PROPERTIES OF THE DANUBE,

Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia); and Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia). For primary bibliographic entry see Field 02E. W71-04592

HYDRAULIC PROPERTIES RELATED TO STREAM REAERATION.

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 05G.
W71-04593

TRITIUM STUDY OF THE MIXING OF WATERS IN LAKES AND ESTUARIES, WITH PARTICULAR REFERENCE TO THE LAKE OF GENEVA AND THE GIRONDE (FRENCH), Paris Univ., Thonon-les-Bains (France). Center for

Geodynamic Research. For primary bibliographic entry see Field 02H. W71-04594

PORTABLE RADIOISOTOPE GAUGES FOR SUSPENDED SEDIMENTS, International Atomic Energy Agency, Vienna

(Austria). For primary bibliographic entry see Field 02J. W71-04595

TURBIDIMETRY: MEASUREMENT OF X- OR GAMMA-ABSORPTION OR MEASUREMENT OF NATURAL RADIOACTIVITY (FRENCH), Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires. For primary bibliographic entry see Field 02J. W71-04596

THE MASS OF LABELLED INJECTION SEDI-MENTS FOR USE IN A RADIOACTIVE TRACER EXPERIMENT IN DYNAMIC SEDI-MENTOLOGY (FRENCH),

Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires. For primary bibliographic entry see Field 02J. W71-04597

TRACER DISPERSION IN GROUNDWATER EXPERIMENTS.

Institute of Nuclear Physics, Krakow (Poland). For primary bibliographic entry see Field 02F. W71-04598

Field 07—RESOURCES DATA

Group 7B—Data Acquisition

USE OF GAMMA EMISSION FROM AMER-ICUM-241 TO MEASURE THE WATER CON-TENT OF NONSATURATED SOIL SAMPLES TENT C. (FRENCH),

(France). Laboratoires de Mecanique des Fluides.

For primary bibliographic entry see Field 02G. W71-04599

WATER-FLOW CALCULATIONS BY MEANS OF GAMMA-ABSORPTION AND TENSIOME-TER FIELD MEASUREMENTS IN THE UN-SATURATED SOIL PROFILE,

Niedersaechsisches Landesamt Bodenforschung, Hanover (West Germany); and Bundesanstalt fuer Bodenforschung, Hanover (West Germany)

For primary bibliographic entry see Field 02G. W71-04600

PENETRATION RADIOACTIVE LOGGING FOR THE STUDY OF NON-SATURATED AND SATURATED AREAS (RUSSIAN),

All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (ÚSSR). For primary bibliographic entry see Field 04B. W71-04601

APPLICATION OF THE SINGLE-WELL TECHNIQUE THROUGH THE LABELLING OF THE WHOLE PIEZOMETRIC COLUMN (SPANISH), Ministry of Public Works, Madrid (Spain). Dept. of

Nuclear Applications.
For primary bibliographic entry see Field 02F.
W71-04602

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RADIOMETRIC METHOD FOR INVESTIGAT-ING THE PERMEABILITY OF RESERVOIR BEDS (RUSSIAN),

Polish Academy of Sciences, Gdansk. Inst. of Hydraulic Research.

For primary bibliographic entry see Field 04A. W71-04603

NEUTRON INVESTIGATION OF THE RATE OF WATER SEEPAGE FROM IRRIGATION CHAN-

NALES AND RESERVOIRS IN LOCASIAL LOAMS (RUSSIAN),
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 04A.
W71-04604

THE USE IN HYDROLOGY OF ISOTOPES PRODUCED BY PEACEFUL UNDERGROUND NUCLEAR EXPLOSIONS (RUSSIAN), Hydrometeorological Service of the USSR, Moscow. Inst. of Applied Geophysics.
For primary bibliographic entry see Field 08H. W71-04605

THE ENERGY BALANCE CLIMATOLOGY OF A CITY-MAN SYSTEM,

California Univ., Los Angeles. Dept. of Geography. For primary bibliographic entry see Field 02A. W71-04753

SOME TIME AND SPACE RESOLUTION REQUIREMENTS FOR SPACE OCEANOG-RAPHY,

Bureau of Commercial Fisheries, Galveston, Tex. For primary bibliographic entry see Field 05A. W71-04801

PULP MILLS TAKE TO THE AIR TO MONITOR OCEAN OUTFALLS.

Oregon State Univ., Corvallis. For primary bibliographic entry see Field 05A. W71-04825

7C. Evaluation, Processing and **Publication**

MAP SHOWING AREAS SERVICED BY MUNICIPAL AND PRIVATE WATER-DISTRIBUTION AGENCIES, SAN FRANCISCO BAY REGION, 1970,

Geological Survey, Washington, D.C. J. T. Limerinos, and Karen Van Dine.

Geological Survey Basic Data Contribution 4 (Map), 1970. 1 sheet, 2 map.

Descriptors: *Water distribution (Applied), *Water supply, *Distribution systems, *California, Conveyance structures, Pipelines, Water districts, Potable water, Sanitary engineering, Water delivery, Water management (Applied), Water works.

Identifiers: *San Francisco Bay region, *Water distribution agencies.

Eighty-four areas serviced by municipal and private water-distribution agencies, in 9 counties of the San Francisco Bay Region in 1970, are shown on this map. The counties included are Alameda, Napa, San Francisco, Santa Clara, Solano, Contra Costa, Marin, San Mateo, and Sonoma. The names of the agencies are also included. In addition to that map, an index map showing the 9 Bay area counties and the names of topographic map sheets is on the container cover. (Woodard-USGS) W71-04366

MAP SHOWING AREAS SERVICED BY MU-NICIPAL AND PRIVATE SEWERAGE AGEN-CIES, SAN FRANCISCO BAY REGION, 1970, Geological Survey, Washington, D.C. J. T. Limerinos, and Karen Van Dine.

Geological Survey Basic Data Contribution 5 (Map), 1970. 1 sheet, 2 map.

Descriptors: *Sewerage, *Sewage districts, *Maps, *Sewage disposal, *California, Pipelines, Conveyance structures, Municipal wastes, Domestic wastes, Networks, Regions, Water districts, Sanitary engineering, Water management (Applied). Identifiers: *San Francisco Bay Region, Sewerage agencies.

One-hundred-sixteen areas serviced by municipal and private sewerage agencies, in 9 counties of the San Francisco Bay region in 1970, are shown on this map. The counties included are Alameda, Contra Costa, Marin, San Francisco, Napa, Solano, San Mateo, Santa Clara, and Sonoma. Related information shows sewerage agency boundaries, sewerage subarea boundaries, sewerage outfalls, seweragetreatment plants, and sewerage-discharge lines. In addition to that map, an index map showing the 9 Bay area counties and the names of topographic map sheets is on the container cover. (Woodard-USGS) W71-04367

COMPUTER SIMULATION OF URBAN STORM WATER RUNOFF.

Water Resources Engineers, Inc., Walnut Creek, Calif.

For primary bibliographic entry see Field 04C. W71-04574

DIGITAL COMPUTER SIMULATION OF WASTE TREATMENT PLANTS USING THE WATCRAP-PACER SYSTEM,

Waterloo Univ. (Ontario). Dept. of Chemical Engineering. P. L. Silveston.

Water Pollution Control, Volume 69, No 6, p 686-693, 1970. 8 p, 5 fig, 4 tab, 6 ref, 1 append.

Descriptors: Digital computers, *Simulation analysis, *Waste water treatment, *Computer programs. Identifiers: Computer subroutines, Ontario.

The initial phase of an investigation of the adequa-cy of process models available in sanitary and chemical engineering and a demonstration that suitable sets of process models are capable of reproducing the performance of operating waste-treatment plants were discussed. The WATCRAP-PACER, a digital computer program which simulated the behavior of plants treating domestic and/or industrial waste waters was developed for use by engineers with minimal knowledge of computers and programming. First the general program, PACER, was described as having an executive program and a library of subroutines which model unit processes and operations such as mixing, chemical reactions, and distillation. A recycle system determined by the executive program of PACER was shown. For simulation of streams in a waste treatment plant network, 'information' con-tent for each stream was used by and stored in the PACER executive as a stream variables list or vector. A short vector consisting of the standard tests used to characterize wastes and a long vector consisting of BOD, total and volatile suspended solids, as well as temperature and alkalinity was used in the WATCRAP program. The WATCRAP PACER system was applied to a conventional activated-sludge treatment plant at Kitchener and a trickling filter plant at Oshawa in Ontario. (Kriss-Cornell) W71-04772

08. ENGINEERING WORKS

8A. Structures

MAP SHOWING AREAS SERVICED BY MUNICIPAL AND PRIVATE WATER-DISTRIBUTION AGENCIES, SAN FRANCISCO BAY REGION, 1970,

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07C. W71-04366

PROCEEDINGS WORKSHOP ON STREAM CHANNELIZATION AND WETLAND DRAINAGE.

North Carolina Water Resources Research Inst., Raleigh.

For primary bibliographic entry see Field 04A. W71-04673

AMENDED 1964 MASTER PLAN OF WATER-WORKS IMPROVEMENTS FOR BOARD OF WATERWORKS COMMISSIONERS, MADISON, WISCONSIN, 1969 REVISION. Black and Veatch, Kansas City, Mo.

Board of Waterworks Commissioner, Madison, Wisconsin, April 28, 1969. 60 p, 6 fig, 13 tab.

Descriptors: *Municipal water, *Water supply, *Water works, *Planning, *Administration, Project planning, Water demand, Deep-well pumping, Construction costs, Water conveyance, Computer programs, Water wells, Cities, Future planning, Wisconsin.

Identifiers: *Waterworks improvements, Madison.

A study was conducted to: (1) review and amend a 1964 Black and Veatch Master Plan of Waterworks Improvements as supplemented by a 1967 University Study; (2) correlate new potential develop-ment areas located beyond the present water ser-vice area with the Madison utility facilities; (3) evaluate water use and development trends during the past five years; and (4) modify previously recommended improvements resulting from the past five years; and (4) modify previously recommended improvements resulting from changed conditions. The recommendations made to the City of Madison are: (1) continue planning to serve a population of 240,000 by 1980; (2) give consideration to computerizing the tabulation of water sales to provide water-use records; (3) provide for a 1980 maximum daily demand rate of 73 mgd; (4) install 167,000 feet of water mains during 1969-1974 and 198,300 feet during 1975-1980: (5) replace the two Dayton Street Reservoirs: (6) modify existing unit well station booster pumping facilities to change discharge gradients and capacities; (7) construct three new unit well supplies before 1974 and one between 1975 and 1980; and (8) construct five new ground storage reservoirs with a total capacity of 9 mg. In addition, miscellaneous improvements to booster stations, unit wells and water mains are recommended. The cost estimate the initial (1969-1974) construction is \$5,202,800. Additional requirements during the 1975-1980 period are estimated at \$4,626,000. (Poertner) W71-04678

THE FINITE DAM II,

Western Australia Univ., Nedlands.

P. B. M. Roes

Journal of Applied Probability, Vol 7, No 3, p 599-616, December 1970. 18 p, 3 fig, 11 ref.

Descriptors: *Water allocation (Policy), *Weirs, *Water balance, Inflow, Overflow, Laplaces equation, Markov processes, Time. Identifiers: *Finite dam.

A weir of capacity K was considered in which the water inflow was a process with stationary independent increments. When the weir was empty, there was a continuous release of water at unit rate; if K was infinite the weir became full in which case the excess water overflowed instantaneously. A weir for which K was infinite was referred to as an infinite dam. Its transient behavior was well known if the input possessed a second moment. A complete description of the process which used the Laplace transform (L.T.) of the Laplace Stieltjes transform (L.S.T.) was presented. The dam processes considered were Markov processes. L.S.T.'s of first entrance and taboo first entrance times and first skip times and taboo first skip times were determined From the (taboo) first entrance and skip times, first entrance times for the finite dam were derived, which led to the renewal functions of the renewal processes imbedded in the finite dam content process v* (t) and hence to the transient behavior of the finite dam. The advantage of this approach was that it seemed entirely probabilistic and avoided involved analytic arguments. (Kriss-Cornell) W71-04771

8B. Hydraulics

MEASUREMENT OF VARIABLE FLOW PAT-TERNS BY A METHOD INVOLVING DILU-TION OF RADIOACTIVE TRACERS (FRENCH), Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

J. Guizerix, R. Margrita, J. Molinari, B. Gaillard,

and P. Calmels

and r. Calmels.

In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/27, p 463-477, 1970. 15 p, 10 fig, 2 ref.

Descriptors: *Discharge measurement, *Tracers, *Tracking techniques, *Mixing, Streamflow, Hydraulic models, Model studies, Flowmeters, Path of pollutants, Unsteady flow, Non-uniform flow, Diffusion, Dispersion. Identifiers: *Mixing (Tracers).

Measuring variable water flow patterns is an important problem for the calibration of limnimetric stations and certain hydroelectric installations, and also for determining the pollution of industrial ef-fluents. Although the flow pattern is linear with respect to the tracer, the water and tracer, taken together, form a non-linear system. The conditions for linearizing the problem were studied in an ex-perimental channel. As the tracer is injected at a constant rate, continuous measurements of its concentration are made in a section downstream. An analysis of the problem and the method of calculating flow are presented. Very good agreement is shown to obtain between the flow thus calculated and the flow measured by a turbine at the entrance to the channel. (Knapp-USGS) W71-04383

THE CONCEPT OF 'GOOD MIXING' IN THE USE OF TRACERS: DISCHARGE VELOCITY AND VELOCITY OF THE CENTER OF GRAVI-TY OF A TRACER CLOUD IN FLOW STUDIES (FRENCH).

Toulouse Univ. (France). Institut de Mecanique des Fluides; and Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes

M. Alquier, J. Gruat, G. Courtois, and G. Sauzay. In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/26, p 441-461, 1970. 21 p, 4 fig.

Descriptors: *Tracers, *Tracking techniques, *Mixing, Diffusion, Streamflow, Measurement, Statistical methods, Probability, Dispersion, Dye releases, Radioisotopes, Tagging, Discharge (Water), Discharge measurement. releases,

Identifiers: *Mixing (Tracers), *Streamflow trac-

In measuring flows by means of tracers it is common to use integration methods which use the concept 'condition of good mixing'. This relation is general, regardless of the method used, and may be deduced from general definitions of perfect tracers and of the extent to which the flow is represented by the tracer. It appears to be a necessary and suffi-cient condition for measuring flow by tracers, independent of the initial injection conditions. A relation can therefore be established between the flow and one or more characteristic parameters of the movement of the tracer. For example, in the methods using the velocity of the center of gravity of a cloud of tracer, there is a relation between this velocity and the mean velocity of the fluid. The value of the ratio between these two velocities is a function of the profile of the velocities of the flow studied. This calculation makes use of the theory of probability and principles of fluid mechanics. A number of methods use the idea of the mean time of transit between two given sections. Formulas used in these calculations are listed. (Knapp-USGS) W71-04384

APPLICATION OF PROBABILITY TO SPILL-WAY DESIGN FLOOD ESTIMATION,

State Rivers and Water Supply Commission, Melbourne (Australia).

G. N. Alexander.

In: Floods and Their Computation, Vol 1, International Association of Scientific Hydrology Publica-tion No 84 (Unesco-WMO), p 536-543, 1969. 8 p, 3 fig, 19 ref.

Descriptors: *Probability, *Design flood, *Probable maximum precipitation, *Flood forecasting, *Peak discharge, Discharge (Water), Rainfall-runoff relationships, Reservoir design, Flood control, Statistical methods, Risks, Depth-area-duration analysis.

Identifiers: Spillway design flood, Australia.

There are two schools of thought concerning the estimation of floods which should be adopted for the design of spillways for large dams. The first is the method of Probable Maximum Precipitation (PMP). This method uses the maximization and transposition of storms and avoids any reference to The second uses procedures of mathematical statistics to determine the required capacity for a selected level of probability. There are serious limitations at present in both approaches: in the first, the limitation is inherent, for PMP cannot be

quantitatively defined and hence estimates are primarily matters of judgment; in the second, the procedures have not been sufficiently developed to be acceptable to the engineering profession generally. The discussion of the problems includes: (a) the purely mathematical problem of estimating the probability of occurrence of an event in a given period such as the 'life' of a dam given the return period of the event; (b) the socio-economic problem of estimating the risk to be stipulated for spillway design floods, as influenced by the number and life of dams; (c) some mathematical probability procedures using distributions in time and space for estimating rare events; in particular the observed data can be 'extended', provided that the initial data are statistically homogeneous. (Knapp-W71-04389

COMPUTATION OF DESIGN SPRING FLOOD HYDROGRAPH,

All-Union Designing, Surveying and Scientific Research Inst. Hydroproject, Moscow (USSR). G A Leskov

In: Floods and Their Computation, Vol 2, International Association of Scientific Hydrology Publica-tion No 85 (Unesco-WMO), p 722-727, 1969. 6 p, 3 fig, 1 tab.

Descriptors: *Design flood, *Snowmelt, Hydrographs, Flood forecasting, Reservoir design, Flood control, Probability, Frequency analysis, Peak discharge. Identifiers: USSR.

When designing hydraulic structures on rivers and reservoirs and determining spillway capacity and dimensions for controlling high floods, it is necessary to evaluate not only the design discharge of the river at the proposed dam site but also to have a hydrograph of the entire flood wave for a given design probability. The procedure developed in the 'Hydroproject', USSR, allows, under condition of availability of a long series of river runoff observations, calculation and plotting of a flood hydrograph corresponding to the given probability of in-stantaneous discharge and that of maximum runoff for periods of one day and longer. The proposed procedure may be applied to rivers on which the pearly flood peak can easily be determined. (K-napp-USGS) W71-04405

STOCHASTIC MODEL FOR SAND DISPER-SION.

Illinois Univ., Urbana. Water Resources Center; Illinois State Water Survey, Urbana; and Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics. For primary bibliographic entry see Field 02J. W71-04573

VERTICAL DENSITY CURRENTS--II. Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02H. W71-04606

MATHEMATICAL MODEL FOR WATER DIS-TRIBUTION SYSTEMS,

Arya Mehr Industrial Univ., Tehran (Iran).

Méhdi S. Zarghamee.

Journal of the Hydraulics Division, ASCE, Vol 97, No HYl, p 1-14, January 1971. 15 p, 8 fig, 1 tab, 5 ref, 2 append.

Descriptors: *Mathematical models, *Computer program, *Water distribution (Applied), Steady flow, Simulation analysis, Network design, Hydrau-

Identifiers: *Hardy Cross method, *Newton iteration method, Nonlinear equations, Iran, Chizar reservoir, Niavaran reservoir.

A mathematical model was developed for predicting the steady-state flow pattern for a water distribution system consisting of conduits, pumps,

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Group 8B—Hydraulics

pressure reducing valves, and reservoirs. The model was a computerized numerical simulation of the network. Each component was assumed to be governed by a specific, characteristic flow formula which in most cases was nonlinear. The equilibrium of flow in the network was governed by a system of nonlinear equations which were solved by the Newton iteration method. A great deal of numerical effort was saved by combining several conduits that were formulated to form an equivalent conduit. The mathematical model developed was coded in a computer program and was verified against the Hardy Cross method which involved joint relaxation in contrast to the proposed method where the entire network was relaxed simultaneously. Comparison revealed that the rate of convergence of the proposed method was greater than that of the Hardy Cross method. The existing water distribution system which supplies water to the Chizar area, Tehran, Iran, consisting of the Chizar reservoir and the Niavaran reservoir, served as an example for analysis of the method described. (Kriss-Cornell) W71-04775

8C. Hydraulic Machinery

OPTIMIZATION OF AN ELECTRODIALYSIS

McDonnell Douglas Astronautics Co., Newport Beach, Calif. Water Technology Dept. George Belfort, and John A. Daly. Desalination, Vol 8, No 2, p 153-166, October 1970. 14 p, 7 fig, 3 tab, 8 ref.

Descriptors: *Optimization, *Simulation analysis, *Mathematical models, *Digital computer, *Electrodialysis, Costs, Operations, Streams, South Dakota, Desalination. Identifiers: Webster (S Dak).

Using models of both the cost procedures and the physical plant design, an optimization routine was constructed for an electrodialysis plant. An introduction to previous optimization studies, including a frequently used linear model was presented first. A detailed description of the combined simulation model, used as the kernel of the optimization routine, was divided into two parts: a model of the electrical properties of the electrodialysis stacks and a model of the costs associated with a given plant design. The two models were combined and programmed for a digital computer. In order to discover the optimum configuration, the independent or decision variables used were: (1) the stack

design to be used; (2) the number of parallel streams in the plant; (3) the number of stages or stacks per stream; and (4) the reduction of salt concentration that was to be accomplished in each stage. A flow chart for the program was given and the optimization process where two or more stack designs were compared for particular application was summarized. The algorithm was applied to plant requirements at Webster, South Dakota and compared actual cost and operating conditions with optimal and nonoptimal conditions. Other uses of the model were also considered. (Kriss-Cor-W71-04767

8D. Soil Mechanics

GROUNDWATER MEASUREMENTS AT THE SITE OF THE SYLVENSTEIN DAM IN THE BAVARIAN ALPS,
Gesellschaft fuer Strahlenforschung m.b.H., Mu-

Institut (West Germany). Radiohydrometrie. For primary bibliographic entry see Field 02F. W71-04385

DETERMINING CHARAC-SEEPAGE TERISTICS OF MILL-TAILINGS DAMS BY THE FINITE-ELEMENT METHOD Bureau of Mines, Spokane, Wash. Mining Research

C. Daniel Kealy, and Richard A. Busch.

Report of Investigations 7477, January 1971. 113 p, 2 tab, 34 fig, 52 ref, 4 append.

Descriptors: Mine wastes, Waste disposal, *Mine drainage, Mine water, Groundwater movement, Waste dumps, Hydraulic models, *Seepage, Environmental engineering, Environmental sanitation, Slope stability, Soil physical properties, Mathematical models, *Earth dams, Phreatic lines. Identifiers: *Tailings dams.

Finite-element, mathematical models that solve LaPlace's or Richard's equation numerically were used to locate the phreatic surface within tailings pond embankments and to define the subsurface flow of water from the pond. Both must be known to design structurally and environmentally safe tailings dams. The permeability distribution within and beneath the embankment, and the geometry and elevation of an approximately impermeable layer at some depth beneath the embankment, were used as inputs in analyzing over a dozen finiteelement models of tailings dams varying from simple to complex. Results predicted with the finite-element model were confirmed with measurements in a laboratory model of a tailings pond and in the field. Of particular importance to the design of safe slopes, all data indicated that the phreatic surface within a tailings dam is concave upward, a configuration opposite that in most earth dams. The close correlation between predicted and experimental values confirmed the practicability of using the finite-element technique to design safe tailings dams. W71-04425

8H. Rapid Excavation

THE USE IN HYDROLOGY OF ISOTOPES PRODUCED BY PEACEFUL UNDERGROUND NUCLEAR EXPLOSIONS (RUSSIAN), Hydrometeorological Service of the USSR, Moscow. Inst. of Applied Geophysics. Yu. A. Izrael', and F. Ya. Rovinskiy. In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/59, p 815-820, 1970. 6 p, 1 fig, 1 tab.

Descriptors: *Nuclear engineering, *Nuclear explosions, *Hydrogeology, *Tracers, *Path of pollutants, Radioisotopes, Radioactive wastes, Tritium, Groundwater movement. Excavation. derground. Identifiers: *USSR, *Nuclear explosions (Underground).

Various isotopes produced during the construction of hydraulic engineering works by means of underground nuclear explosions are discussed with reference to their use as tracers for the investigation of the hydrological regime in the construction area. An assessment is given of the relative yields of the isotopes, their capacity to pass into aqueous solutions and their migration potential, taking into account their distribution over the various zones and carrier particles and the effects of fractionation. It is concluded that the best tracer for solving hydrological and hydrogeological problems is triti-um. Study of the migration of other isotopes is im-portant from the point of view of possible radioac-tive contamination of water. Experimental data are given on the migration of radioactive isotopes during construction of a model reservoir in the Soviet Union and on the role of these isotopes in the study of the hydrological regime of the reservoir. (K-napp-USGS) W71-04605

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- Ground and surface water hydrology at the Water Resources Division of the U. S. Geological Survey, U. S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the EPA-Water Quality Office, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.
- Water well construction technology at the National Water Well Association.

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- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.
- Agricultural livestock wastes at the Department of Agricultural Engineering of Iowa State University.
- Methods for chemical and biological identification of pollutants at the Battelle Memorial Institute.
- Coastal pollution at the Oceanic Research Institute.

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